RADIOLOGY

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RADIOLOGY

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Henry Ford Hospital, Detroit 2, Mich.

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Primary Intraventricular Tumors[1]

ROBERT P. BOUDREAU, M.D.[2]

INTRACRANIAL tumors which are primarily of intraventricular origin are exceedingly rare, and by primary intraventricular tumors we mean those arising from cells which normally line the ventricles, *i.e.*, ependymal cells and those of the choroid plexus. We do not include tumors which originate elsewhere and project into the ventricles, or those such as epidermoids and meningiomas which develop within the ventricles from cell rests.

Ependymomas comprise only a small percentage of the intracranial neoplasms reported by Bailey and Cushing, 3 per cent (3); Bennett, 3 per cent (4); Ringertz and Reymond, 6 per cent (18); Zülch, 4 per cent (25); and Svien, 9 per cent (22). Tumors arising from the lining cells of the choroid plexus are even more rare, forming but 0.6 per cent of Bailey and Cushing's cases, 1 per cent of Ringertz and Reymond's, and 0.5 per cent of Zülch's series.

Considerable controversy is encountered in the literature as to the pathological classification of ependymomas. Virchow is credited by Zülch with first describing an ependymoma in 1863 (25). Mallory, in 1902, described cytoplasmic granules within the cells of certain gliomas which he called blephoroplasts, thereby indicating that these tumors were of ependymal origin. Bailey and Cushing in 1924 and 1926 were the first to separate and define as a specific pathological entity tumors which arose from ependyma (2, 3). Kernohan in 1937 (11) divided the ependymomas into epithelial, myxopapillary, and cellular types. Although of some benefit for descriptive purposes, this classification is of little value in estimating biologic activity inasmuch as biologic behavior depends more upon the degree of cellular anaplasia than upon cell type. Classification upon the latter basis, therefore, has failed to find favor with many pathologists, who prefer a simpler division of ependymal tumors into benign and malignant types.

A further difficulty in classification arises in some of the more malignant and undifferentiated tumors, where it is almost impossible to determine with certainty whether the lesion is primarily of ependymal origin or is a glioma including ependymal elements which are not actually contributing to its growth. Tumors of the subependymal glia may project into the ventricle and include ependymal elements which make a definite differentiation difficult if not impossible. Within any series, however, there are only a few cases in which such difficulty in classification will arise, and about which there might be dispute among pathologists. These are probably statistically unimportant, but

[1] From the National Hospital for Nervous Diseases at Queen Square and the Atkinson Morley's Branch of St. George's Hospital, London, England. Presented at the Forty-fifth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 15–20, 1959. This work was undertaken while the author was a National Institutes of Health Fellow for the National Institute of Neurological Diseases and Blindness.

[2] At present Associate Professor of Radiology, University of Maryland, Baltimore, Md.

they do give rise to some uncertainty when series from different clinics are compared.

Similar controversy has been encountered in the classification of choroid plexus papillomas. Davis and Cushing (6) differentiated papillomas from the papillary type of ependymoma. Ringertz and Reymond also believe that choroid plexus papillomas should be separated from the ependymomas because of a difference in histologic appearance and biologic activity. Kernohan groups such tumors with the ependymomas. Again it is relatively easy to identify a typical, well differentiated choroid plexus papilloma, but the true identity of some of the more malignant, undifferentiated forms is at times difficult to ascertain. Zülch, in fact, believes that many tumors labeled malignant choroid plexus papillomas are, more likely, metastatic implants in the brain from an unsuspected primary source. Most authors, however, divide choroid plexus papillomas into benign and malignant types.

In spite of the extensive literature regarding the pathological appearance of intracranial intraventricular tumors, there has been little written concerning their radiological characteristics except for isolated case studies. This paper is a report on the radiologic manifestations of a series of primary intraventricular neoplasms collected from the National Hospital for Nervous Diseases at Queen Square and the Atkinson Morley's Branch of St. George's Hospital, London.

All of the primary intraventricular tumors which had been diagnosed at these two hospitals for a period of ten years were collected. A total of 62 cases were discovered. Only those were included in this study, however, in which radiologic investigation was followed by histologic examination of material obtained at operation or postmortem. Fifty-four cases fulfilled these criteria, 46 of ependymoma and 8 of choroid plexus papilloma.

AGE AND SEX INCIDENCE

No predilection for either sex was found in this series, which included 25 males and 29 females. The age incidence is outlined in Table I. The youngest patient was an infant of three months; the oldest a female of sixty-five years. Six tumors were seen before three years of age. The age distribution correlates with that generally reported, with the highest incidence in the first two decades.

TABLE I: AGE INCIDENCE OF 54 PRIMARY INTRAVENTRICULAR TUMORS

Age	0–10	11–20	21–30	31–40	41–50	51–65	Total
Ependymomas	19	8	6	9	2	2	46
Choroid Plexus Papillomas	1	1	2	3	0	1	8
TOTAL	20	9	8	12	2	3	54

PATHOLOGY

The intraventricular tumors in this series have been divided into benign and malignant types. It is well known that any one of these tumors may vary in morphology from location to location, and the specimen obtained may not be an accurate representation of the neoplasm's dominant characteristic. In those lesions, therefore, in which the histologic picture was equivocal but which were observed to be infiltrating or locally invasive, the gross appearance was also considered in determining malignancy. The results of pathological classification are summarized in Table II.

TABLE II: HISTOLOGIC CLASSIFICATION OF 54 PRIMARY INTRAVENTRICULAR TUMORS

	Benign	Malignant
Ependymomas	29	17
Papillomas	5	3
TOTAL	34 (63%)	20 (37%)

The percentage of malignancy is approximately that found by Svien *et al.* in their series at the Mayo Clinic (22). The fact that approximately one-third of these tumors are malignant refutes the contention that they are indolent by nature and malignant only because of their predilection for the floor of the fourth ventricle (5). The proportion of malignant choroid plexus

papillomas is much higher than that reported by Posey in a collection of 86 cases from world literature, of which only 10 per cent were malignant (17). Our series of such tumors, however, is too small for statistical evaluation or comparison.

SITE

The site of these neoplasms within the brain is summarized in Table III. The site designated is the one at which the tumor was thought to have originated, although there may have been involvement of more than one ventricle. Ependymomas are thought to arise at the flexures of the ventricular system wherever ependymal cells pile up in the subependymal layers, *i.e.*, at the ventricular outlets and at the insertions of the tela choroidea. Above the tentorium these tumors arise most commonly at the trigone, at the foramen of Monro, or in the roof of the third ventricle. Below the tentorium intraventricular neoplasms have a predilection for the floor of the fourth ventricle, the anterior medullary velum, and for the lateral recess of the fourth ventricle. Those originating in the lateral recesses may simulate cerebellopontine-angle lesions (12).

TABLE III: SITE OF 54 PRIMARY INTRAVENTRICULAR TUMORS

Site	Ependymomas	Papillomas
Supratentorial		
Lateral ventricle	10	4
Third ventricle	5	0
Extraventricular	1	0
Total	16 (34%)	4
Infratentorial		
Fourth ventricle	29	3
Extraventricular	1	1
Total	30 (66%)	4

These neoplasms have multiple potentialities for growth and may also have their source in cell rests outside the ventricular system (11). Such cell rests have been described in various locations, with no apparent predilection for any one area (11, 18, 25). Origin in the pituitary fossa has been reported, with simulation of a primary pituitary lesion both clinically and radiologically (20). In one case in our series a pituitary origin was suggested clinically, but the tumor actually arose in the optic chiasm. The lesions may grow into the dura, calvarium, and scalp, as well as extend extracranially (17, 13, 16).

Wherever their origin, these tumors may spread beyond the site of their original growth *via* the spinal fluid pathways (23). They may do this without actually showing any histologic evidence of malignancy. Their spread is summarized in Table IV.

TABLE IV: SPREAD OF 54 PRIMARY INTRAVENTRICULAR TUMORS

	Localized	Intracranial Spread	To Spinal Cord
Ependymomas	20	25	4
Papillomas	2	6	0

Although extension along the spinal cord is relatively infrequent, spread within the intracranial ventricular and subarachnoid pathways beyond the original site is not unusual. An extreme example of such growth was seen in one of our cases in which the tumor was originally found at operation in the right posterior temporal region on the surface of the hemisphere communicating with the lateral ventricle. At a second operation, several months later, the left cerebellar hemisphere was invaded. Still later, at postmortem, lesions were found in both lateral ventricles and the third and fourth ventricles. The tumor had also extended *via* the subarachnoid pathways to the optic chiasm, around the medulla, pons, cerebellum, and into the spinal cord.

The cases in this series have been analyzed to see whether any relationship exists between the age of the patient, the origin of the tumor, and its malignancy. In all age groups almost as many tumors were found above the tentorium as below it. The percentage of malignant tumors was as great in the younger as in the older group. Age of the patient, therefore, was of no value in predicting either the malignancy or site of origin. Analysis also reveals that no relationship existed between the tumor site and malignancy, because as

many malignant tumors were supratentorial as were infratentorial.

CLINICAL FEATURES

Intraventricular neoplasms had no common denominator as far as their clinical characteristics were concerned except that signs and symptoms were usually specific enough to indicate the presence of a space-occupying lesion either above or below the tentorium. The single most important factor in determining the clinical picture was the location or site within the ventricular system. Relatively small lesions obstructed the ventricular system in the posterior fossa, thereby producing symptoms earlier than did those above the tentorium, which had to be of larger size in order to become symptomatic. Those tumors, therefore, which arose infratentorially generally had a shorter history than did those arising above the tentorium. Whether a tumor originated above or below the tentorium was, in fact, more important than malignancy in determining the interval between the onset of symptoms and the time of diagnosis.

Operability of the neoplasm found at the time of surgery was also influenced more by the site of tumor growth, and hence by its size, than by its malignancy. Because they were discovered earlier and were smaller, lesions arising in the posterior fossa could be removed *in toto* more frequently than could the larger supratentorial tumors.

The course subsequent to operation was likewise affected by the site and size of the lesion more than by the histologic degree of malignancy found at operation, except where the tumor was grossly widely invasive. Survival figures were as follows:

Survived	25 (46%)
Died	29 (54%)
Postoperatively	16
Later	7
Without operation	6

The position of the tumor as it affects survival is summarized in Table V. From these figures it can be deduced that fewer

TABLE V: POSITION OF TUMOR IN RELATION TO SURVIVAL

	Died	Survived
Supratentorial	8 (40%)	12 (60%)
Postoperatively	2	
Later	4	
Without operation	2	
Infratentorial	21 (62%)	13 (38%)
Postoperatively	14	
Later	3	
Without operation	4	
Total	29 (54%)	25 (46%)

of the patients with infratentorial lesions survived operation than of those with supratentorial tumors. It was found, however, that when a patient survived operation there was a smaller number of serious neurological defects when the tumor was located below the tentorium than when it originated above the tentorium. Nine of the 12 patients (75 per cent) with supratentorial lesions had significant neurological defects following operation, whereas only 4 of the 13 patients (33 per cent) with infratentorial lesions had such defects. Final or long-term figures are not available. These, however, presumably will not be as high as those presented here because a number of patients survived the operation and the immediate postoperative period very well, although a grossly infiltrating tumor was left behind at operation.

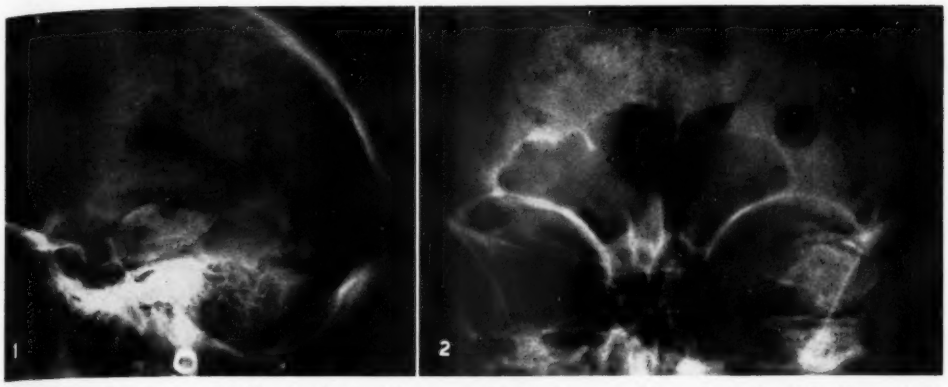
RADIOLOGICAL ASPECTS

All of the patients in this series had plain skull films. The findings are summarized in Table VI. The plain skull

TABLE VI: RADIOLOGIC FINDINGS IN 24 PRIMARY INTRAVENTRICULAR TUMORS

	Ependymomas	Papillomas	Total
Plain skull changes	20 (40%)	3	23
Calcification	6 (6%)	2	8
No detectable changes	25 (50%)	3	28

changes tabulated were suture diastasis in patients in the first decade of life and erosion of the dorsum sellae after the age of closure of the sutures. These changes were, of course, entirely nonspecific as to the etiology of the space-occupying lesion



Figs. 1 and 2. Case P. T. Calcification in the left temporal lobe, demonstrable on both the plain film and the ventriculogram.

present except for calcification, the distribution of which generally indicated the presence of a neoplasm. It can be seen that in slightly less than half of these cases changes were demonstrated on the plain films suggesting the presence of a space-occupying lesion.

Only 11 per cent of these neoplasms showed calcification radiologically, although in slightly more than twice that number some calcium was found to be present histologically. The calcification occurred in malignant as well as benign lesions. It showed no particular configuration or distribution which might lead one to favor a particular type of tumor, except in one case:

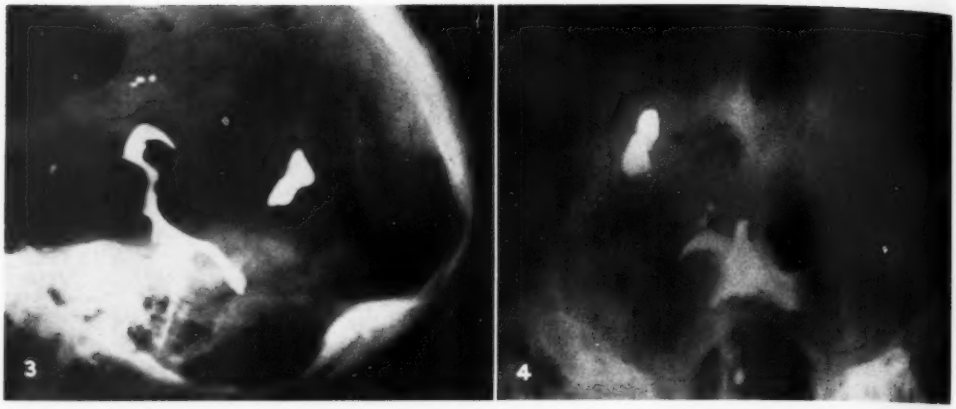
P. T., a 23-year-old female, had suffered from grand mal attacks for seven years. Physical examination was negative. Plain films of the skull showed a large circumscribed calcific mass in the left temporal lobe. The general shape and position of this mass suggested that it formed a cast of a dilated temporal horn. Ventriculography confirmed this suspicion (Figs. 1 and 2), and it was further established at operation. The tumor was removed *in toto*, and pathological examination showed it to be a choroid plexus papilloma. No neurological deficit persisted after the operation.

Fifty-one patients in this series had further studies which were of aid in localizing and identifying the space-occupying lesion more precisely. In no instance did arteriography demonstrate any distinctive characteristics which would permit differentiation from other types of tumor. No tumor stains were seen. Ventriculography and encephalography, as might be expected, were the only methods available for identifying an intraventricular neoplasm and for differentiating it from other intracranial gliomata. An intraventricular tumor can be suspected only if the greater part of the bulk of the lesion can be surrounded by air in such a way that its intraventricular site can be demonstrated. For this the tumor must be relatively small. Many films in various projections, with a horizontal as well as a vertical beam, are necessary.

It is in the posterior fossa that an intraventricular position of a neoplasm is most likely to be demonstrated. This can be attributed to the fact, alluded to previously, that lesions involving the fourth ventricle are smaller when first discovered than those originating above the tentorium. The smaller the lesion the more likely it is to be surrounded on three sides by air.

The following is an example of the type of case in which an intraventricular origin can reasonably be suggested.

E. B., a 49-year-old female, had complained of headaches and loss of vision for two months. She had experienced some vomiting and weight loss for eighteen months. Immediately prior to admission to the hospital she suffered attacks of dizziness followed by falling and loss of consciousness, and she had complained of excessive thirst. Physical examination revealed bilateral anosmia, reduced vision, and bilateral papilledema. Ventriculography demonstrated dilatation of the lateral and third ventricles. Myodil outlined an irregular, dilated



Figs. 3 and 4. Case E. B. Benign ependymoma arising from the floor of the fourth ventricle and extending into the aqueduct.

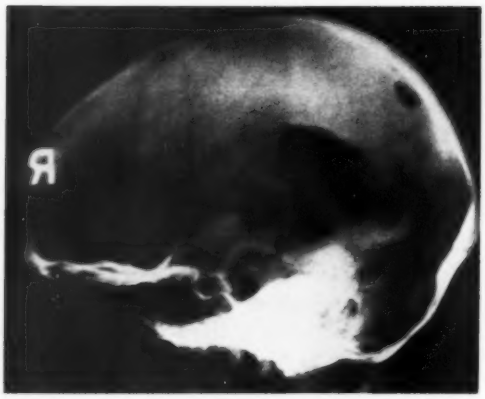


Fig. 5. Case P. P. Anterior displacement of aqueduct with failure of filling of fourth ventricle.

aqueduct and a dilated, deformed ventricle into which projected a mass surrounded on three sides by contrast material. This suggested an intraventricular origin with spread into the aqueduct (Figs. 3 and 4). At operation a tumor arising from the floor of the fourth ventricle was partially excised. Ventricular drainage was instituted. The patient died postoperatively. At postmortem a tumor was found extending from the floor of the fourth ventricle into the aqueduct. Histologic examination revealed a benign ependymoma.

Not all lesions involving the fourth ventricle can be outlined, however, in the manner just described.

P. P., a 30-year-old female, gave a history of long-standing headaches with recent exacerbations. Physical examination revealed bilateral papilledema, left facial weakness, and questionable left hemiparesis. Ventriculography showed dilatation of the lateral and third ventricles. The aqueduct was displaced forward but despite manipulation the fourth ventricle could not be filled (Fig. 5). At operation a tumor was found arising in the region of the vermis, filling the fourth ventricle and extending into both cerebellar hemispheres. Excision appeared to be total. Histologic examination revealed a malignant ependymoma.

Supratentorial lesions tended to be larger when first discovered, and their intraventricular origin generally could not be demonstrated. An example of a supratentorial tumor in which an intraventricular origin could be suggested follows:

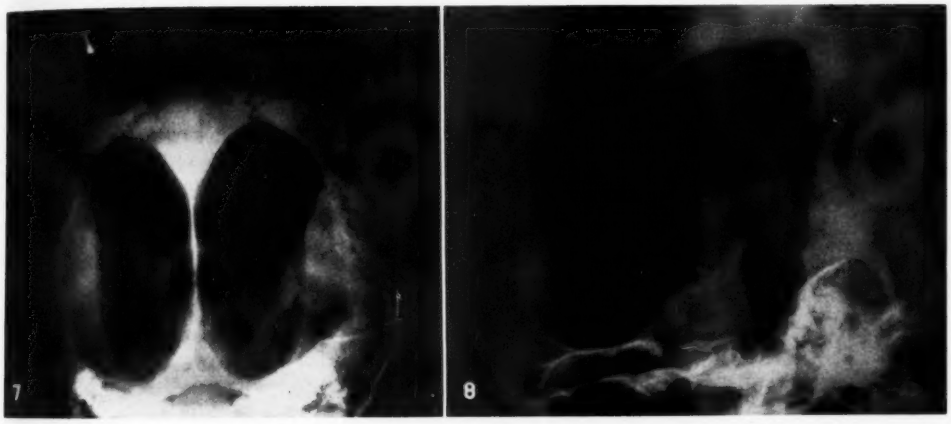
W. E., a 56-year-old male, complained of occipital headaches. Epileptic attacks had occurred for six months and had become progressively worse. Mental deterioration gradually became marked. The patient was admitted to the hospital in a stuporous condition. Physical examination revealed right pyramidal signs. Ventriculography disclosed a mass involving the right frontal horn which apparently arose from the medial portion of the floor of the right lateral ventricle and the septum and bulged into the ventricle (Fig. 6). Operation through a right frontal approach showed a large lobulated mass arising from the floor of the frontal horn, extending backward to the foramen of Monro. The tumor was removed completely, but the patient never recovered consciousness and died the day of the operation. Histologic examination revealed a benign ependymoma.

Using the most careful technic, we were able to diagnose the intraventricular origin of the lesion in only 5 cases. In 8 more cases an intraventricular origin was suspected from the air studies. This

Fig. 6. Case W. E. Supratentorial tumor in which an intraventricular origin was suggested by ventriculography.

stated, tumors of the lateral recess of the fourth ventricle may simulate cerebellopontine-angle neoplasms. Lesions of the floor of the third ventricle may simulate other conditions in this area, as in the following case:

C. S., a two-and-one-half-year-old girl, had become increasingly irritable for three months. She complained of headache for the same period and vomiting of seven weeks duration. Physical examination revealed a hyperresonant percussion note throughout. The head was enlarged. Marked lateral nystagmus and ataxia were present. Ventriculography showed symmetrical dilatation of the lateral ventricles and a large filling defect involving the greater part of the third ventricle. This appeared to arise from the ventricular floor, sparing the region of the foramen of Monro and the roof of the third ventricle behind the foramen (Figs. 7 and 8). The patient grew rapidly worse upon admission to the hospital and died four days afterward despite ventricular drainage. Postmortem a tumor was found filling the third ventricle, extending into the aqueduct, fourth ventricle, and brain stem. Histologically it was a malignant ependymoma.



Figs. 7 and 8. Case C. S. Symmetrical dilatation of lateral ventricles and large filling defect involving greater part of third ventricle.

makes a total of only 13 cases at most in which the diagnosis of intraventricular tumor could be suggested, and in only 5 of these could this be supported with reasonably secure evidence. It follows that, although these neoplasms can be satisfactorily localized within the brain by air studies, in only one-fifth of the cases at best can their intraventricular origin be suspected or demonstrated.

When an intraventricular origin cannot be demonstrated, these tumors resemble other intracranial gliomata. Because of the fact that the spread is often far beyond the site of origin within the ventricular system, as well as into the subarachnoid pathways, almost any type of deformity can be produced. As already

Although it is not unusual to find cyst formation histologically in the ependymomas, cystic change of such proportions that it can be detected grossly or radiologically is no more common than in other gliomata. Only one patient in our series had a radiologically demonstrated cyst.

D. J., a two-and-one-half-year-old boy, had experienced epileptic attacks for three months, associated with twitching of the right hand, arm, and

Fig. 9. Case D. J. Cyst formation in a malignant ependymoma.

leg. A limp gradually developed. Vomiting started two weeks before admission. Physical examination revealed a slight bilateral papilledema and questionable right homonymous hemianopia. A positive Babinski sign was present on the right. Ventriculography showed a large cystic cavity with a mural nodule involving a large part of the left cerebral hemisphere (Fig. 9). At operation there was found a large cyst with a mural nodule involving the entire left parietal area and infiltrating the hemisphere deeply. As much as possible of the tumor was removed. Histologic examination showed it to be a malignant ependymoma.

It is evident that the diagnosis of an ependymoma or choroid plexus papilloma may be reasonably suggested only if one is able to demonstrate the intraventricular origin of the tumor with some degree of certainty. Once this was done, however, no distinguishing characteristics were noted which would permit us further to differentiate such primary intraventricular tumors from each other or from other secondary intraventricular neoplasms such as epidermoids or meningiomata. The surface configuration of the intraventricular extension of the lesion may be smooth or irregular, although in none of our cases was the irregularity so pronounced as to suggest the presence of an epidermoid tumor. In addition, some extraventricular neoplasms actually may simulate intraventricular lesions by projecting their main bulk into the ventricular system. Tumors which arise from the subependymal glia are particularly prone to simulate intra ventricular neoplasms in this manner (21).

Subarachnoid spread is, of course, even more difficult to estimate than is ventricular extension, and it must be rather extensive before it can be detected or even suspected. If, in addition to a space-occupying lesion demonstrated elsewhere, there is deformity of the basal cisternae, floor of the third ventricle, or upper cervical region, such subarachnoid spread may be suspected.

As might be expected, these tumors generally produced blockage of the ventricular system to some degree, the majority of them resulting in ventricular dilatation of varying proportion proximally. The dilatation, however, was not such that it was an important point in differentiating such lesions from other gliomata.

DISCUSSION

Analysis of the facts presented leads one to the conclusion that in the majority of instances intraventricular tumors are extremely difficult if not impossible to diagnose by any of the clinical or radiologic means available to us. The age incidence of these neoplasms is of some slight aid in this respect, more of these tumors occurring in patients in the first two decades of life. Other criteria, such as the duration of symptoms, site of growth, amount or type of calcification, and size or extension of the tumor are of no differential aid. Only by demonstration of the intraventricular origin of the neoplasm by air study can its true nature be suspected. This can be done in a very small percentage of cases. The somewhat better prognosis which these tumors as a whole imply makes it worthwhile to attempt to separate intraventricular from other intracranial gliomata.

Because site of origin appears to be the most significant factor in determining the clinical and radiologic picture, as well as operative mortality, it is best to consider supratentorial and infratentorial intraventricular tumors as separate entities. These two groups have little in common except their histology.

The extraventricular ependymomas or

choroid plexus papillomas defy differentiation or preoperative diagnosis because they arise and have their principal growth outside the ventricular system. In view of the multiple potentialities as to origin and growth which these lesions present, almost any type of neoplasm may be simulated.

SUMMARY

1. Primary intraventricular tumors are rare and are difficult to differentiate clinically, radiologically, and at times pathologically, from other intracranial tumors.

2. Site of origin is the single most important factor in determining the clinical and radiologic findings as well as the operative survival.

3. Although a single histologic entity, supratentorial and infratentorial intraventricular tumors must be considered separate entities for clinical and surgical purposes.

4. The only radiologically distinguishing characteristic which can be relied upon is demonstration of the intraventricular origin of these tumors by air study, which can be accomplished in a very small percentage of cases.

ACKNOWLEDGMENTS: I wish to express my appreciation to the Medical Committee of the National Hospital, Queen Square, and to Mr. Wylie McKissock for permission to use the cases and clinical material reported here. I also wish to thank Dr. James Bull for his help and advice.

University Hospital
Baltimore 1, Md.

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(Pro le summario in interlingua, vider le pagina sequente)

SUMMARIO IN INTERLINGUA

Primari Tumores Intraventricular

Primari tumores intraventricular emerge ab cellulas que revesti normalmente le ventriculos, i.e. cellulas ependymal e cellulas del plexo choroidic. Le presente reporto es basate super 54 tal casos in patientes de inter 3 menses e sexanta-cinque annos de etate. Quaranta-sex del 54 esseva casos de ependymoma e 8 casos de papilloma del plexo choroidic. Dece-septe del tumores in le prime e 3 de illos in le secunde gruppo esseva maligne.

Le etates del patientes non esseva correlationate con le sitos del origine del tumores o con lor malignitate e benignitate. Similemente, nulle correlation existeva inter le malignitate o benignitate del tumores e le sito de lor location (infra o supra le tentorio).

Le differentiation inter istos e altere tumores intracranial es difficile clinicamente, radiologicamente, e a vices etiam pathologicamente. Nulle adjuta es a trovar in criterios como le duration del symptomas, le sito del crescentia, le grado o type del calcification, e le dimension o extension del tumor. Le ver natura del tumor pote esser suspicite solmente super le base del demonstration del origine intraventricular del neoplasma per medio de un studio a aere. Iste methodo pote esser utilisate solmente in le micre procentage de casos in que un parte major del massa pote esser circumdate de aere. Le sito de origine es le plus importante factor individual inter le determinantes del constatationes clinic e radiologic e del superviventia post-operatori

A causa de iste factos, tumores supratentorial e tumores infratentorial in iste gruppo—ben que illos es histologicamente identic—deberea esser considerate como entitates separate ab le punctos de vista clinic e chirurgic.

The Radiological Changes and Clinical Incidence of Endocrine Effects in Sellar and Parasellar Tumours[1]

H. F. W. PRIBRAM, M.A., M.B., B. Chir. (Cantab.), D.M.R.D.,[2] and G. F. SWANN, M.B., M.R.C.P., D.M.R.D.

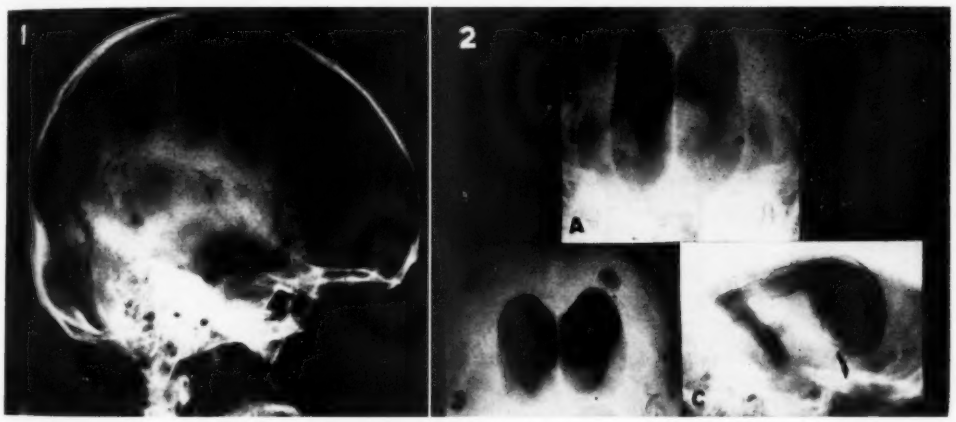
THE INVESTIGATION to be reported here was prompted by an unusual case of pituitary neoplasm.

A married woman of 52 was first seen as an outpatient complaining of loss of memory and sleepiness. A few days later she was admitted to the hospital in coma. Clinical examination showed her to be demented and disoriented. Careful testing disclosed no visual field defect. There were no endocrine disturbances and the urinary ketosteroids were normal. A clinical diagnosis of frontal lobe tumour was made.

A roentgenogram of the skull showed the pituitary fossa to be enlarged and eroded from within. At encephalography very little air entered the ventricular system, and the third ventricle was not filled. The air did, however, outline a tumour arising from the pituitary fossa (Fig. 1) and a radiological diagnosis of pituitary tumour with suprasellar extension was made. Some widening of the cortical subarachnoid channels was noted anteriorly.

The patient's condition continued to deteriorate and ventriculography was performed in order to demonstrate the third ventricle. In anteroposterior views a filling defect, very like that of a colloid cyst of the third ventricle, was seen deforming the inferomedial borders of the lateral ventricles, but in the lateral view the third ventricle was seen to be displaced backward (Fig. 2). The lesion could not, therefore, be a colloid cyst, and the findings supported the original diagnosis.

The patient was transferred to a neurosurgical centre, where a diagnosis of glioma of the third ventricle was made and a craniotomy performed. At autopsy a huge pituitary adenoma was found. The absence of field defects was explained by the presence of a prefixed optic chiasm. The optic nerves were short, and the tumour had grown upward and backward, like a mushroom, sparing the optic tracts.



Figs. 1 and 2. Chromophobe adenoma (Case 50).

Fig. 1. Air encephalogram showing air in the pontine and chiasmatic cisterns outlining the "stalk" of a pituitary tumour.

Fig. 2. Ventriculogram showing a rounded filling defect projecting into the inferior and medial aspects of the lateral ventricles. The appearances are very like those of a colloid cyst of the third ventricle except that the third ventricle is shown to be displaced backward (C).

Since the absence of endocrine changes in this case remained unexplained, it was decided to investigate the endocrine aspects of pituitary and parapituitary tumours and their relationship to radiological changes. Accordingly, a number of cases of chromophobe adenoma, craniopharyngioma, suprasellar meningioma, and raised intracranical pressure with an enlarged third ventricle were selected at random. The

[1] From the National Hospital, Queen Square (H.F.W.P.), and Westminster Hospital (G.F.S.), London, England. Accepted for publication in May 1960.

[2] Now at the University Hospital, Edmonton, Alberta, Canada.

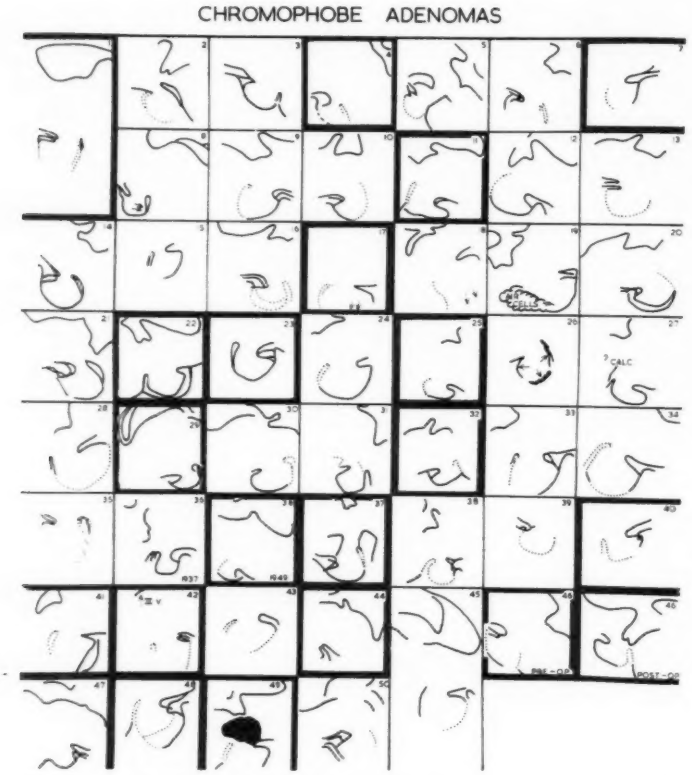


Fig. 3. Chart of the tracings of the pituitary fossa and ventricular system in 50 cases of chromophobe adenoma. Those showing endocrine signs have been edged with a thick black line. Case 49 on the chart shows (in black) the chiasmatic cistern filled with air along the side of the "stalk" of the tumour, but note the upward displacement of the anterior end of the third ventricle.

TABLE I: SEX AND AGE DISTRIBUTION OF PATIENTS*

Age in Years	0–9	10–19	20–29	30–39	40–49	50–59	60–69	Total
Chromophobe adenoma	0	4	2	10	17	15	2	50
Men	0	3	2	8	11	8	0	32
Women	0	1	0	2	6	7	2	18
Craniopharyngioma	16	12	5	3	6	5	3	50
Men	10	8	1	2	1	4	1	27
Women	6	4	4	1	5	1	2	23

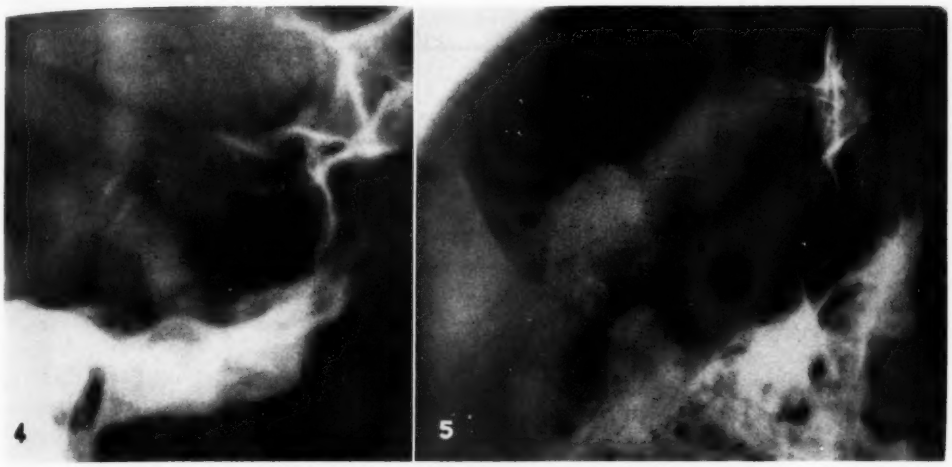
* It will be seen that the highest incidence of chromophobe adenomas is between the ages of thirty and sixty, while the majority of the craniopharyngiomas occurred under the age of twenty. Even so, almost half of the craniopharyngiomas were in patients over twenty.

assessment of endocrine changes has been made on clinical grounds only, as none of the patients had had an adequate endocrine survey.

CHROMOPHOBE ADENOMAS

Fifty cases of chromophobe adenoma were studied. The eldest patient was fifty-nine and the youngest fifteen years of age; the majority were between the ages of thirty and sixty. Thirty-two were male and 18 were female (Table I).

The tracings of the pituitary fossa and ventricular system were included in a chart (Fig. 3), those showing endocrine changes being edged with a thick black line.



Figs. 4 and 5. Chromophobe adenoma.
Fig. 4. Plain film of the pituitary fossa. Note the elevation of the anterior and posterior clinoid processes, and the ballooning of the pituitary fossa—the classical picture of a pituitary adenoma.
Fig. 5. Ventriculogram showing elevation of anterior end of the third ventricle with obliteration of the chiasmatic and infundibular recesses.

A characteristic pattern of radiological changes was found in the majority of cases. The pituitary fossa is nearly always enlarged. The dorsum sellae is thinned and frequently destroyed inferiorly. The posterior clinoid processes are pushed back and often only a ghost remains where the floor of the fossa has been destroyed. The anterior clinoid processes are in many instances elevated and undercut (Fig. 4). Calcification almost never occurs but a suggestion of it was seen in Case 27.

It should be noted that when the sella has been completely destroyed so that all "reference" points have disappeared, it is not possible to say whether the destruction has been brought about by an intrasellar tumour or not. Thomson (6) came to a similar conclusion.

In all but 2 cases, Nos. 2 and 36, the tumour extended beyond the sella, displacing or deforming the third or lateral ventricle. The first radiological indication of this is to be found in the blunting or obliteration of the optic and infundibular recesses (Fig. 5). The tumour is often mushroom-shaped and at encephalography the chiasmatic cistern may be filled with air on either side of the stalk. It is most important, therefore, to demonstrate the anterior end of the third ventricle, and autotomography (7, 8) may be necessary. Case 49 on the chart shows a normal chiasmatic cistern (in black) with the third ventricle displaced upward.

Endocrine disturbances were found in 21 of the 50 cases, and this incidence is in general accord with other series (1, 5). As might be expected, they were more frequent in the younger age groups. Changes in the growth and distribution of hair were the most commonly recorded findings. Skin changes were next in frequency, followed by obesity and hypogonadism. Polyuria and polydipsia were uncommon. No skeletal surveys were available.

Two cases of typical Fröhlich syndrome were encountered, Case 22, in a girl, and Case 48, in a boy. Both were aged fifteen and both presented with headache, optic atrophy, and visual field defects. One patient, Case 11, was a Lorraine dwarf, who was referred with signs of raised intracranial pressure. His family doctor had been treating him with tablets for underdevelopment, so that his presenting symptoms were perhaps endocrine in nature. A spinster of fifty-two, Case 36, was first seen with visual failure and a bitemporal hemianopia. Ventriculography was nor-

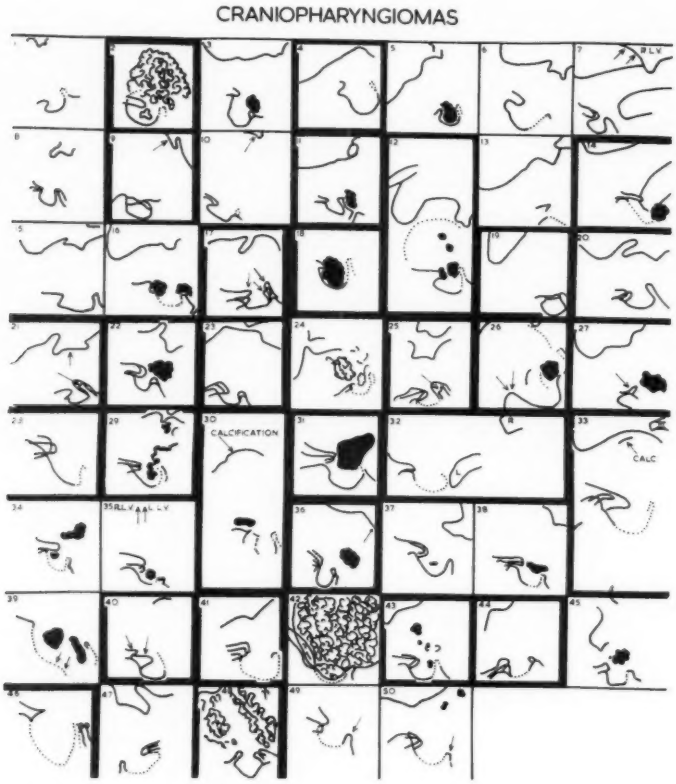


Fig. 6. Chart of the tracings of the pituitary fossa and ventricular system in 50 cases of craniopharyngioma. Those edged with a thick black line (except Case 24) showed endocrine disturbances.

mal and operation showed no evidence of pituitary tumour. Twelve years later, when over sixty, blind in one eye and almost so in the other, she was seen again, her chief complaints being polyuria and polydipsia. Ventriculography this time revealed an expanded and eroded sella and an elevated third ventricle.

Endocrine changes might reasonably be expected to occur either from pressure on the pituitary or, alternatively, through pressure on the hypothalamus. It is therefore disappointing to find that no correlation exists between the amount of sellar destruction and the occurrence of endocrine disturbances. Thus, in both Cases 35 and 43 there was extensive sellar destruction, but no evidence of endocrine deficiency. Cases 25 and 32 showed little destruction and had only small suprasellar extensions, but signs of hypopituitarism were present in both.

In an attempt to relate the suprasellar extension of the chromophobe adenomas to the occurrence of endocrine changes, the height of the third ventricle above the sella turcica was measured in the 41 patients who had had air studies by the method described by Bull (3). No difference in the average height of the anterior end of the third ventricle above the sella was recorded between those patients showing endocrine changes and those who did not, nor was there any difference in the range of values. Thus in both series there were tumours reaching more than 3 cm. above the sella and there were also cases in both series with only small suprasellar extensions.

Case 1, with a huge suprasellar tumour,

showed endocrine changes but Case 45 with an equally large tumour showed none. In another case (not included in the series) what behaved like a chromophobe adenoma without any endocrine changes proved on histologic examination to be an almost pure eosinophil tumour. Another pituitary adenoma proved to be malignant. The patient in this case is alive and well twelve years after operation. In the small number of pituitary carcinoma cases examined, the changes in the sella turcica and the survival rates were no different from those in which the tumor was benign. In this series the majority of patients had postoperative radiotherapy.

CRANIOPHARYNGIOMAS

Fifty unselected case records of craniopharyngioma were examined. The ages ranged from six and a half years to sixty-seven; 28 patients were under twenty, 25 being under sixteen; almost half were over twenty. Twenty-seven were male and 23 were female (Table I). A chart of the pituitary fossa and the ventricular system (Fig. 6) was made in the same way as for the chromophobe adenomas.

Again, in the craniopharyngiomas a pattern of radiological changes was recognised. The pituitary fossa was far less frequently enlarged, even in the presence of intrasellar calcification. The posterior clinoid processes were deformed in a characteristic fashion, being hollowed out or flattened from above (Fig. 7). Undercutting of the anterior clinoid processes occurred only in the presence of an enlarged pituitary fossa.

Calcification was seen in 28 cases in all; in 17 (72 per cent) of the 25 patients under the age of sixteen; in 11 (44 per cent) of those over sixteen years. This confirms the findings of other authors, who have noted that the majority of craniopharyngiomas in childhood show calcification (1, 2, 5). Its position varied: intrasellar, suprasellar, or remote. Calcification was frequently flocculent, but in Case 33 it consisted of a curvilinear streak similar to that found in large aneurysms.

Fig. 7. Craniopharyngioma (Case 25). Plain film of the pituitary fossa showing semilunar erosion of one of the posterior clinoid processes and enlargement of the pituitary fossa with undercutting of the anterior clinoid processes.

This finding, which is stressed by Bull (2), makes angiography imperative. All patients showed deformities in the ventricular system, indicating suprasellar extension or origin.

Endocrine changes were found in 30 cases: 28 with evidence of hypopituitarism, 1 with endocrine overactivity, and 1 with a mixture of both. The changes were much more florid than those recorded in the chromophobe adenomas. Changes in the hair and skin were the most common, followed by obesity and hypogonadism. Polyuria and polydipsia were almost as frequent, in contrast to the findings in chromophobe adenoma, where these latter two disturbances were uncommon.

Case 26 was that of a boy of sixteen with a slipped femoral epiphysis. He showed a typical Fröhlich syndrome and questioning revealed that he had always had "blinker" vision which he had accepted as normal. This was the only case presenting unequivocally as an endocrine disorder. Another boy, Case 40, six and a half years old, was seen with visual field defects, polyuria, and polydipsia, but the genitalia were large and there was a good growth of pubic hair. This is an odd mixture of over- and underactivity of the endocrine system.

Fig. 8. Craniopharyngioma (Case 15). Air encephalogram showing filling defect in the third ventricle and enlarged pituitary fossa with dorsum sellae eroded from above.

Case 6 was most unusual. The patient was first seen at the age of twenty-three, when ventriculography revealed a hydrocephalus. Three years later, when she had a bitemporal inferior quadrant field defect, the hydrocephalus had increased and the third ventricle was displaced upward. She became pregnant, and in October 1940 was delivered of a normal child who was killed by bombs sixteen days later. In 1942 she had another child by caesarean section and afterward had normal menses. The presence of a craniopharyngioma was confirmed by biopsy; by 1945 she was almost blind.

Figure 8 shows the radiograph of Harry, aged nine, who was first seen with headache and visual failure. Following admission papilloedema developed and he deteriorated rapidly. His lesion was considered inoperable and he was discharged to his home. Three years later, a letter was received from the probation officer of a London Magistrate's Court requesting information regarding his illness as he had been charged with larceny. In the same year his mother wrote asking if it was right for Harry to have started shaving at the age of eleven and why, when he was now thirteen, he looked sixteen!

A further ventriculogram showed the pituitary fossa to be even more enlarged and the third ventricle more elevated but there was no increase in hydrocephalus. When the patient was eighteen his mother wrote again, as Harry had joined the Army, being Grade A1. He had omitted to mention his neurosurgical experiences. Three years later Harry wrote himself: He was fit, well, and in a steady job. It seems, therefore, and other cases confirm this, that it is possible for a patient to live with his craniopharyngioma.

Two further cases (Nos. 5 and 18) were encountered: a boy fifteen and a half, a typical Lorraine dwarf, had a pituitary fossa identical with that of a girl of eight and a half, who showed no endocrine changes.

In the craniopharyngioma series, measurements in the height of the third ventricle above the sella were made as for the chromophobe adenomas, and no relationship to the incidence of endocrine disturbances was found. The greater frequency of hypothalamic disorders in craniopharyngioma, however, is no doubt due to its suprasellar situation. The amount of sellar destruction again had no bearing on the incidence of endocrine changes, and neither had the size of the tumour.

SUPRASELLAR MENINGIOMAS

Only 15 suprasellar meningiomas were studied: most of them spared the pituitary fossa (Fig. 9). Hollowing out of the anterior clinoid processes and flattening of the posterior clinoid processes occur frequently. The third ventricle is elevated and its recesses are blunted. These tumours can, however, be very small and sometimes form a sleeve around the optic nerves to enlarge the optic foramina. Thirteen out of 15 of these tumours occurred in women. All the patients were over forty-five and presented with visual failure; none had endocrine disturbances.

AQUEDUCT STENOSIS

An enlarged third ventricle behaves like a tumour. It erodes the pituitary fossa, flattens or enlarges it. Anterior and posterior clinoid processes are destroyed from above. The recesses of the third ventricle are often retained even when it is grossly

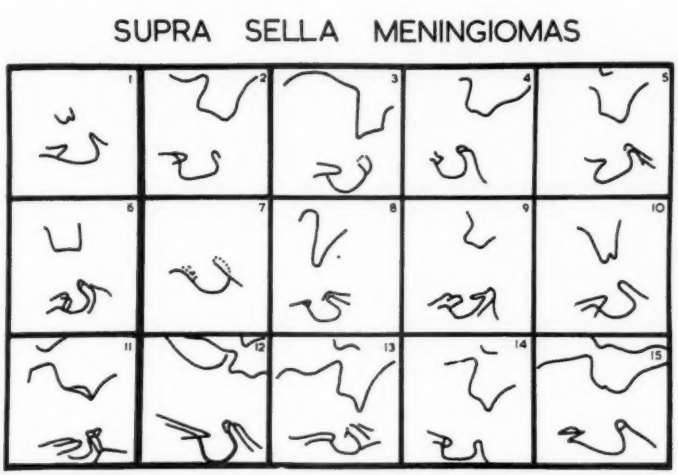


Fig. 9. Chart of the tracings of the pituitary fossa and ventricular system in 15 suprasellar meningiomas.

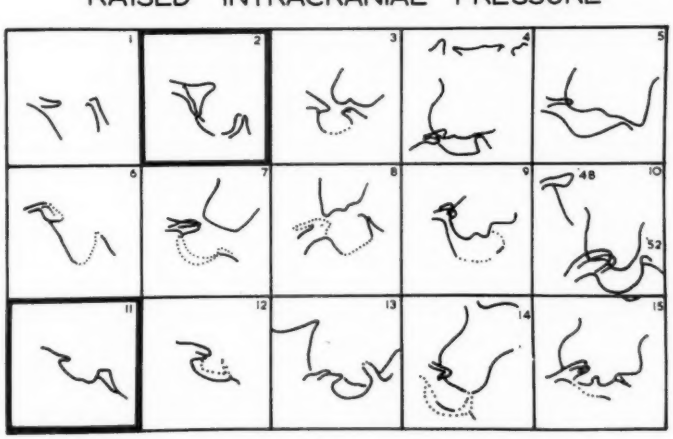


Fig. 10. Chart of the tracings of the pituitary fossa and ventricular system in 15 cases of aqueduct stenosis. Those showing endocrine changes have been edged with a thick black line.

enlarged. Only 2 out of 15 cases showed endocrine changes (Fig. 10).

In Case 11, a man of twenty-one gave a year's history of polyuria and polydipsia. He shaved less frequently and complained of priapism. Case 2 was that of a boy of fourteen who was small and unusually somnolent. He had a dry puffy skin with fine scanty hair and his weight had steadily increased.

Again no relationship between radiological and endocrine changes was found.

SUMMARY AND CONCLUSION

An attempt has been made to relate the radiological changes resulting from sellar and parasellar tumours to the incidence of endocrine disturbances. Fifty chromophobe adenomas, 50 craniopharyngiomas, 15 suprasellar meningiomas, and 15 cases of raised intracranial pressure with the third ventricle acting as a tumour were studied. The radiological changes in the sella and the ventricular system are discussed. The clinical incidence of

endocrine disturbances was found to bear no correlation to the size of the tumours and amount of destruction of the pituitary fossa.

Some unusual problems have been discussed and the need for a full biochemical survey in such patients has become apparent.

ACKNOWLEDGMENTS: We are most grateful to Mr. Wylie McKissock who made the majority of the material available and to Dr. S. P. Meadows, Dr. Hugh Davies, and Dr. James Bull; also to the photographic departments of the Westminster Hospital and the National Hospital, Queen Square, London, England.

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Department of Radiology
University of Alberta Hospital
Edmonton, Alta., Canada

SUMMARIO IN INTERLINGUA

Le Alterationes Radiologic e le Evidentia Clinic de Effectos Endocrin in Tumores Sellar e Parasellar

Esseva facite le tentativa de relationar le alterationes radiologic que resulta ab tumores sellar e parasellar con le incidentia de disturbationes endocrin. Esseva studiate 50 adenomas chromophobe, 50 craniopharyngiomas, 15 meningiomas suprasellar, e 15 casos de augmento de pression intracranial con le tertie ventriculo in le rolo de tumor.

Le elevation del tertie ventriculo supra le sella turcic esseva mesurate per le methodo describite per Bull. Le complexo de alterationes radiologic esseva studiate, specialmente de ille alterationes que indica le dimension e direction crescential del tumor e le presentia o absentia de calcification. Nulle correlation esseva trovate inter ulle alteration radiologic e le evidentia clinic de disturbationes endocrin.

Es signalate le desiderato de un complete investigation biochimic de iste genere de caso.

Percutaneous Aortocerebral Angiography

A Diagnostic and Physiologic Method[1]

GOFFREDO G. GENSINI, M.D., and ARTHUR ECKER, M. D.

THIS REPORT IS of a new standardized method of radiographic visualization of the arch of the aorta, its branches, all the cerebral arteries, cerebral veins, and jugular veins. It is performed, usually under local anesthesia, by percutaneous puncture of the femoral artery for insertion of a plastic catheter. The catheter is advanced under fluoroscopic control to the arch of the aorta. The contrast medium is then injected while serial radiographs or motion pictures are made. This method is useful in cases in which aneurysm, stenosis, occlusion, malformation, or displacement of the affected vessels is suspected. It is also of value for study of the rates of blood flow within individual areas anywhere in the brain. In experienced hands it is safe and reliable and causes the patient little discomfort.

HISTORY

The technic of introduction of large-bore catheters into the aorta *via* percutaneous puncture of the femoral artery has been described by Seldinger (1) and Prioton (2) and modified and reported in detail by Dotter and Gensini (3). For several years sporadic reports (4, 5) of various methods of radiographic visualization of individual branches of the aortic arch have appeared. We know of only two previous accounts (6, 7), however, of complete visualization of these vessels plus the cerebral arteries (total cerebral angiography). Both the methods described depended on intravenous injections of large amounts of contrast material.

Previous attempts to standardize and simplify aortocerebral angiography have been unsuccessful. Either the amount of contrast material was too little (or too dilute) for adequate study or else too strong (and dangerous) a solution was required for vessels leading to the brain. We have devised a modification of the Seldinger technic which was especially adapted to the anatomy and hemodynamics of the arch of the aorta and its branches leading to the upper limbs and brain. Our method is based upon the pattern of blood flow in the aortic arch as demonstrated by contrast material in (*a*) radiographs of patients undergoing visualization of the coronary vessels; (*b*) in glass models; (*c*) in cinefluorographic studies of the aorta in patients suspected of cerebral arteriosclerosis.

METHODS

A special needle (thin-wall 16 G,[2] outside diameter 1.6 mm., inside diameter 1.4 mm.) is introduced with sterile technic into a femoral artery, usually under local anesthesia. The solid stilet of the needle is replaced by a specially constructed stainless steel coil-spring guide.[3] The guide is advanced into the external iliac artery about 8 to 10 cm. past the tip of the needle, which is then removed, leaving the spring in place. A premeasured electronically sterilized #260 PE Intramedic polyethylene tubing (about 100 cm. long, internal diameter 1.77 mm.[4]) with Clay-Adams D Luer-Lok adapter, tapered tip, and three side holes (18), is introduced sleeve-wise over the guide through the skin and then, with a gentle rotary motion, is slid into the femoral artery. The intravascular tips of both guide and tubing are brought close together by adjusting their external ends so that the spring extends 2 cm. beyond the

[1] From the Msgr. Toomey Cardiopuimonary Laboratory and Research Department, St. Joseph's Hospital, Syracuse, N. Y. (Dr. Gensini), and the State University of New York Upstate Medical Center, Department of Surgery (Dr. Ecker). Accepted for publication in May 1960.

[2] Prepared by Becton, Dickinson & Co., Rutherford, N. J.

[3] Custom wound by Syracuse Spring Corporation, Erie Blvd., East, DeWitt, N. Y.

[4] Prepared by Clay-Adams Co., New York, N. Y.

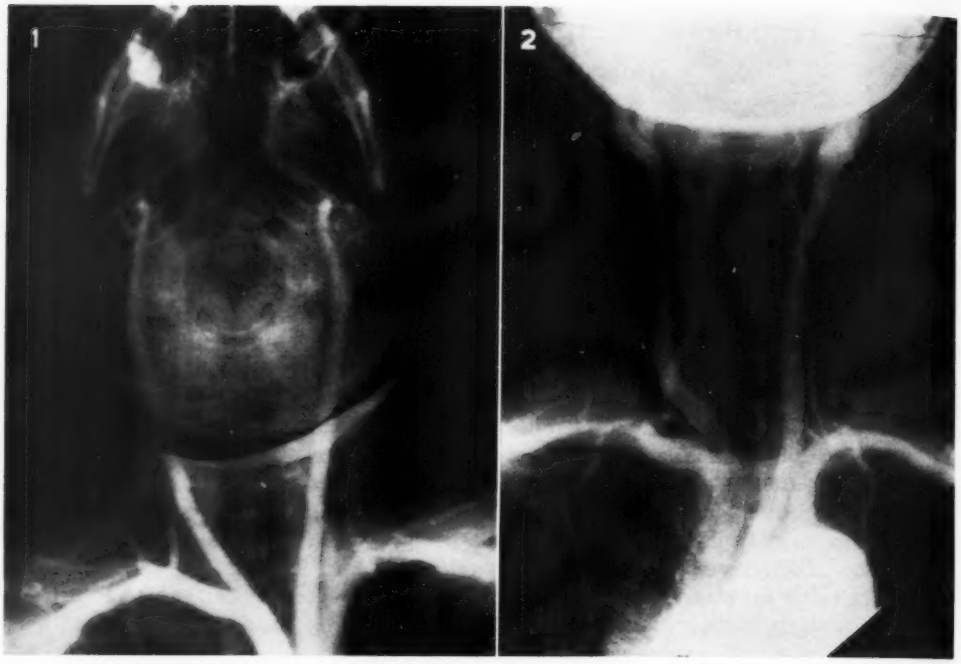

Fig. 1. Aortocervicocerebral arteriogram. Upper chest combined with submentovertical view of skull. Branches of aortic arch, carotid and vertebral arteries are shown.

Fig. 2. Aortocervicocerebral arteriogram. Upper chest combined with submentovertical view of skull. Left vertebral artery is small.

tubing. They are then advanced up the aorta under fluoroscopic control. A satisfactory intra-aortic position of the tips of the guide and tubing (now brought to coincide) is immediately proximal to the ostium of the innominate artery. The guide is removed and 5 c.c. of blood are forcefully aspirated and discarded. The Luer-Lok is then connected to a pressure drip of heparinized saline solution. Five milliliters of 75 per cent Hypaque-M (a mixture of sodium and methylglucamine diacetotrizoate) are injected manually through the tubing. The position of its tip as well as the contrast flow pattern are observed by fluoroscopy, preferably with an image intensifier. This injection also acts as a test of possible sensitivity to Hypaque.

The patient is positioned over the rapid film changer (Schönander seriograph) for occipital (half-axial, Chamberlain-Towne) projections of the skull. The tubing is connected to a Gidlund (9) syringe and 30 c.c. of 75 per cent Hypaque-M, at body temperature, are injected in approximately one second. A series of thirty films is made, starting simultaneously with the beginning of the injection. The first eight films are exposed at the rate of four per second and the remainder at a rate of one and one half per second.

After at least fifteen minutes, another injection is made, the sole change being that only 20 c.c. of contrast agent are used for lateral views of the skull, and the number of films is reduced proportionally to the rate of flow. A third injection may or may not be performed with 25 c.c. of the medium after a further interval of fifteen minutes, for a special view of the upper mediastinum, the neck, and the base of the skull (extended submentovertical view, best made with elevation of the left shoulder). This last projection is especially useful in cases of suspected obstructions of the proximal segments of the brachiocephalic vessels as they arise from the

aorta and pass through the neck to the circle of Willis.

At the end of the procedure—which takes from one to two hours—the polyethylene tubing is withdrawn and the femoral artery compressed manually for a period of fifteen minutes, after which a pressure bandage is applied and the patient is returned to his room.

RESULTS AND COMPLICATIONS

To this date a series of 54 injections in 18 patients has been successfully performed without mortality or significant morbidity. On two occasions a satisfactory puncture of the right femoral artery was not achieved, and the left was used successfully. The patients have experienced only minor discomforts, consisting of a momentary generalized burning sensation, tenderness of a few hours duration, and occasional minimal hematomas at the site of the puncture.

In one case of unilaterally impaired cerebral function the injector, at another hospital, was not strong enough. Nevertheless arterial stenosis was excluded and a temporal lobe mass was suggested. It was necessary, therefore, to perform percutaneous carotid angiography to confirm the diagnosis. It is clear that this method will be fully effective only when the Gidlund or an equally powerful automatic injector is employed, especially for cases of slowed cerebral circulation.

In a single case of our series, in a thirty-nine-year old female, the needle was introduced without difficulty in the right femoral artery but the spring could not be advanced despite repeated attempts. The procedure was then accomplished uneventfully from the left side. Subsequently, there were pallor, coldness, and impairment of sensation of the distal third of the right foot, associated with loss of pulsation in the posterior tibial and dorsalis pedis arteries. Partial recovery took place in a few hours and complete recovery in eighteen hours. We ascribed this occurrence to vasospasm but, regardless of the explanation, a similar phenomenon in the carotid artery might have had permanent serious sequelae.

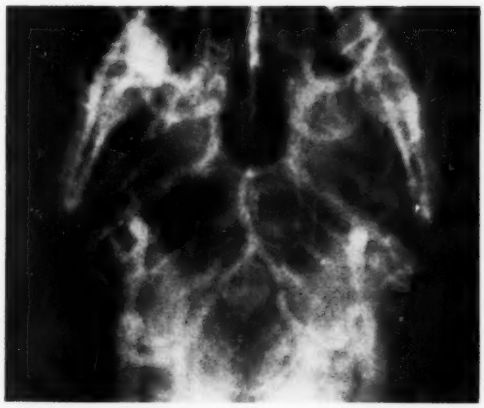

Fig. 3. Aortocerebral arteriogram. Submentovertical view of skull with demonstration of entire circle of Willis. Same case as Fig. 1.

Representative films are shown in Figures 1 and 2, demonstrating the filling of the brachiocephalic vessels, carotid, vertebral, and basilar arteries, and of the entire circle of Willis in the submentovertical view (Fig. 3). Figures 4 and 5 are occipital (Chamberlain-Towne) and Figure 6 a lateral view obtained in the same patient. The venous phase is demonstrated in the occipital (Fig. 7) and lateral (Fig. 8) views.

The striking feature of this technic, offering satisfactory opacification of all the brain and brachiocephalic vessels, is self-evident. The practical value in cases of increased intracranial pressure, as in brain tumors, remains to be determined.

While the technic described offers no special difficulty to any physician well acquainted with the methods of percutaneous arterial puncture and catheterization of systemic vessels, it should not be lightly undertaken by those unfamiliar with these procedures, inasmuch as local and general complications may be easily produced by unskilled hands. We wish specially to emphasize two *potentially* dangerous situations. The first is incident to the introduction of the spring through the needle and into the artery. The danger lies in threading of the spring through perivas-

Fig. 4. Aortocerebral arteriogram. Occipital view. Both internal carotid arteries and the basilar artery and all their main branches are demonstrated.

Fig. 5. Aortocerebral angiogram. Occipital view, same case as Fig. 4 but one-half second later. The internal carotid arteries have emptied, leaving the basilar artery and the posterior cerebrals clearly visible.

Fig. 6. Aortocerebral angiogram. Lateral view of skull showing both carotid and basilar arteries as well as all six main cerebral arteries.

cular tissue, or dissecting the wall of the artery itself, rather than entering the lumen of the vessels. The second concerns the importance of having the tip of the spring under *clear*, unquestionable visual control by fluoroscopy at all times while the instrument is being advanced. The flexible spring readily bends over any obstacle, which is thus demonstrated to the alert operator. With a blind technic it may be impossible to recognize obstacles such as atherosclerotic plaques or accidental insertion of the spring into arterial branches.

DISCUSSION

Positive Advantages (New Information Obtainable by Present Technic): In studying cerebral arteries suspected of stenosis or occlusion, it is desirable to visualize the entire arterial outflow, from the aorta to the brain, as well as the cerebral arteries themselves. Particular emphasis has been placed recently on narrowings at the origin of the main vessels from the aorta and at their subsequent bifurcations in the neck (10) and of the vertebral arteries in their courses through the neck (11). This method of aortocervicocerebral angiography has the advantage of demonstrating all these vessels in a single procedure.

Without mechanical interference with any artery by the needle or catheter itself, the present method permits simultaneous study of blood flow rates in all the main

Fig. 7. Aortocerebral angiogram, venous phase. Occipital view showing both basilar veins, the superior and inferior sagittal sinuses, and both lateral sinuses.

Fig. 8. Aortocerebral angiogram, venous phase, slightly earlier than Fig. 7, showing internal cerebral veins, basilar veins, vein of Galen, straight sinus, and ascending cerebral veins. Same case as Figs. 4–7.

individual arteries and veins of the neck and brain. Specifically, it offers the opportunity of correlating mechanical obstructions in the vessels proximal to the circle of Willis with blood flow studies distal to the circle. There are also opportunities for simultaneous comparison of blood flow in the carotid and vertebral arteries, before and after extending or rotating the head, digital compression of a common carotid artery, or the employment of vasodilating agents, such as carbon dioxide or papaverine.

Beside arteriosclerosis, there are other situations where visualization of both carotid and both vertebral arteries, that is total cerebral angiography, is desirable: (*a*) There are cases of spontaneous subarachnoid hemorrhage, in which there may be no clinical localization or localization may be misleading because of hemorrhage or spasm at some distance from a ruptured aneurysm. No present method of arteriography overcomes severe local arterial spasm, but the technic described here permits filling of all main cerebral arteries. Furthermore, intracranial arterial aneurysms are often multiple. (*b*) There are masses in or near the sella turcica where a knowledge of the relationship of the lesion to both the basilar and carotid systems is desirable before craniotomy. (*c*) There are arteriovenous malformations in the brain which characteristically receive blood from at least two of the six main cerebral vessels. (*d*) There are cases of suspected metastatic malignancy where there may be more than one intracranial lesion. (*e*) There are intracranial masses, that is, brain tumors, abscesses, and hematomas, in general. Besides the radiographic demonstration of these lesions themselves, visualization of all the cerebral vessels may indicate secondary shifts of brain stem and other deep cerebral tissues. Such information may be extremely important to the surgeon. Indeed, in our hands, this method is the most reliable means of performing complete cerebral angiography, or even vertebral angiography alone, whenever these are required. If necessary, in special situations, individual carotid or vertebral angiography can be performed as described later.

Negative Advantages (*Avoidance of Difficulties Inherent in Other Methods*): The present method of angiography is carried out by a single percutaneous puncture

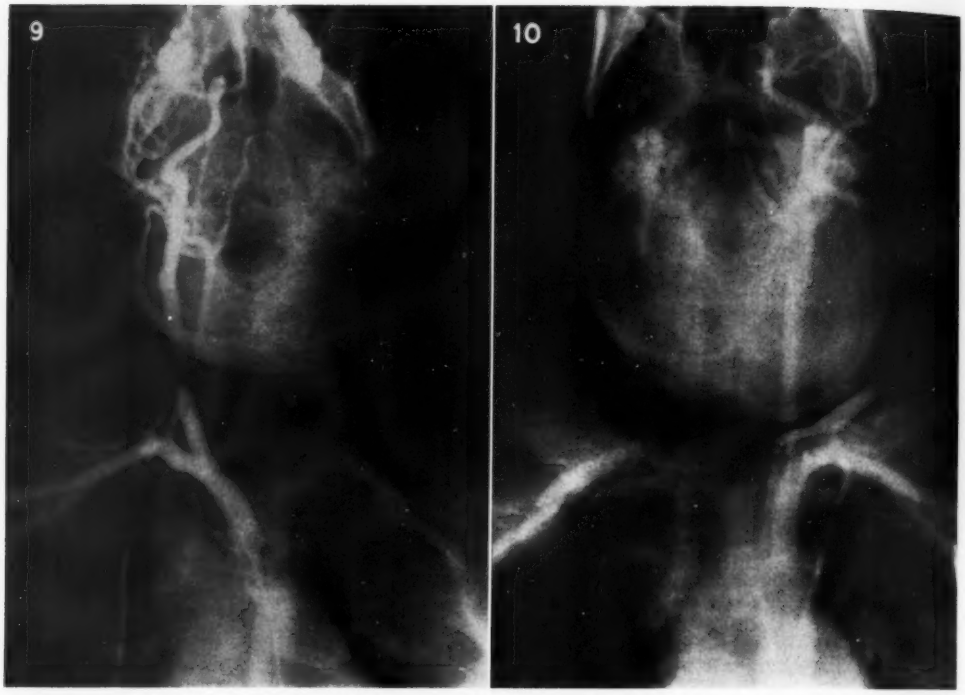

Fig. 9. Aortocerebral arteriogram. Submentovertical view, with catheter inserted into innominate artery. The right carotid, vertebral, anterior, middle, and both posterior cerebral arteries are shown.

Fig. 10. Aortocerebral arteriogram. Submentovertical view. The catheter lies at the middle of the aortic arch. The left carotid, subclavian, vertebral, and middle cerebral arteries are shown. Same case as Fig. 9.

without the need of formal surgical exposure of a vessel. General anesthesia is usually not necessary. When bilateral visualization of both carotid and both vertebral arteries is required, as in the study of arteriosclerosis (12, 13), instead of three or four vessels only one is punctured.

There is no danger of intramural or extramural injection at the wall of a presumably diseased vessel (in cases of arteriosclerosis), namely, the carotid artery or vertebral artery. Dissecting aneurysm (14), temporary occlusion, and even thrombosis of these arteries are thus avoided—all of which can result from misplaced contrast medium. With percutaneous puncture of the carotid artery, compression of the injected vessel with the finger, for at least five minutes, is required after the needle is removed. In the case of a precarious circulation, this may prove to be dangerous.

With the present method, we have not observed the drop in blood pressure and slowing of the heart (15) which are common after percutaneous carotid injection, although we have made continuous electrocardiographic tracings during and following each injection and have taken the aortic blood pressure repeatedly.

When the carotid or vertebral arteries are punctured directly, the blood stream is displaced by the contrast medium (16). This means that while the contrast medium, a noxious agent, is passing through the capillaries, they are not receiving any oxygen-bearing blood. That is, they undergo simultaneous anoxia. With the present method, on the other hand, an appreciable amount (approximately 50 per cent) of oxygen-containing blood is mixed with the contrast material which is passing through the cerebral arteries and capillaries. Perhaps for this reason our patients have

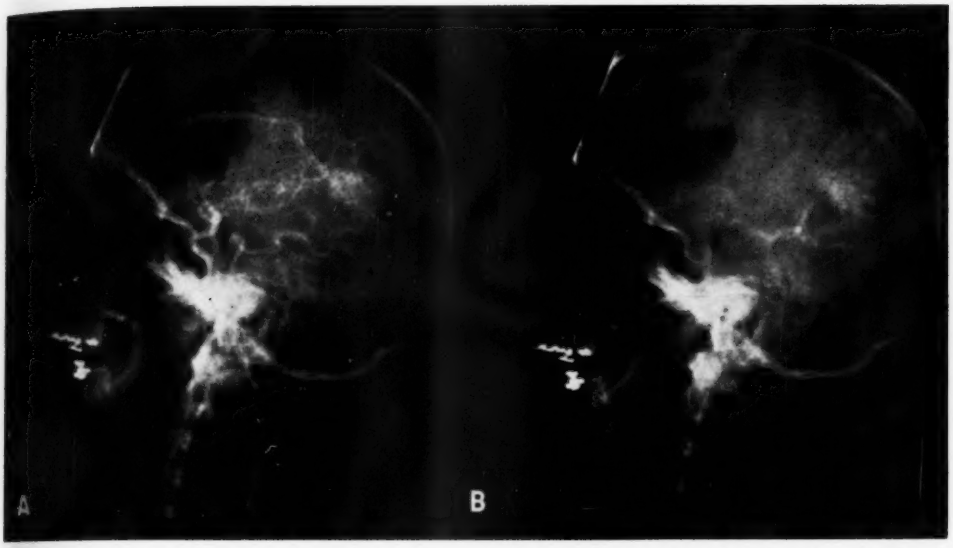

Fig. 11. Arteriovenous malformation of brain demonstrated in aortocerebral angiograms. Lateral views.
A. Arteriogram showing filling by both carotid and basilar systems.
B. Venogram showing drainage into both superior sagittal sinus and basilar vein.

not complained of pain behind the eye, which is routinely experienced in the course of carotid arteriography by direct puncture under local anesthesia.

In the presence of severe stenosis of a carotid or vertebral artery and conventional direct injection into such an artery proximal to the point of stenosis, the contrast medium proceeds further proximally toward the origin of the injected vessel—in the case of the right carotid artery to the innominate, in the left carotid to the aortic arch, and in the case of the vertebral arteries to the subclavian artery. These arteries are then exposed to the contrast medium for two or more seconds. In their branches the flow may be even slower and the exposure time of capillaries longer than two seconds. This may be harmful to the brain (17). On the other hand, with the method described here, the contrast medium injected into the aorta passes across the ostium of the stenosed vessel for not more than one second (the maximal duration of aortic injection), and the stenosed vessel itself will be exposed to contrast medium for not more than one second.

Disadvantages: The present procedure cannot be carried out when there is excessive arteriosclerotic tortuosity or plaque formation of the iliac artery which prevents the catheter from reaching the arch of the aorta. This occurred 4 times in 152 attempts (18) to pass a catheter up the aorta.

Our standard angiographic technic (aortic injection) may not be ideal for study of cases with marked increase of intracranial pressure resulting, for example, from brain tumors. In these cases the cerebral flow may be extremely slow.

Another possible disadvantage of the method is the simultaneous visualization of both internal carotid arteries or both middle cerebral arteries in the lateral projection. These problems may be circumvented by injecting the contrast material directly into the innominate artery for a right-sided visualization (Fig. 9) or immediately distal to the left subclavian for a left-sided study (Fig. 10). Indeed, it may prove to be necessary to advance the catheter into the internal carotid or vertebral arteries. When necessary in special cases, one may rotate the head slightly,

either in a fixed position during serio-angiography or in active movement during cinematography.

SUMMARY AND CONCLUSIONS

A new method is described for the routine radiographic visualization of the arch of the aorta, its branches (the brachiocephalic vessels), all the cerebral arteries, cerebral veins, and jugular veins. This method, ordinarily performed under local anesthesia, and based on the introduction of a guided plastic catheter *via* percutaneous femoral artery puncture, has made possible a series of 54 successful injections in 18 successive clinical cases without mortality or persistent morbidity, and with minimal discomfort to the patient. The practical value of this method in various clinical conditions is suggested.

NOTE: At the time of correcting galley proof (Oct. 21, 1960), a total of 117 aortocerebral injections had been made in 34 patients without significant morbidity.

We are now using Renografin 76 for the procedure because of its lower viscosity and the production of less discomfort to the patient.

St. Joseph's Hospital
301 Prospect Avenue
Syracuse, N. Y.

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SUMMARIO IN INTERLINGUA

Percutanee Angiographia Aortocerebral: Un Methodo Diagnostic e Physiologic

Es describite—sub le designaticn de angiographia aortocerebral—un nove methodo pro le radio-visualisation routinari del arco del aorta, de su brancas (i.e. le vasos brachiocephalic), de omne le arterias cerebral, del venas cerebral, e del venas jugular. Le manovra es ordinarimente executate sub anesthesia local per un punctura percutanee del arteria femoral con le insertion subsequente de un catheter de plastico. Le catheter es avantiate sub observation fluoroscopic usque al arco del aorta. Alora le medio de contrasto es injicite durante que radiogrammas serial o cineradiogrammas es obtenite. Iste methodo es de valor in casos in que aneurysma, stenose, occlusion, malformation, o displaciamento del afficite vasos es suspicite. Illo es etiam de valor in le studio del intensitate del fluxo de sanguine intra areas individual in non importa qual parte del cerebro.

Inter le manos del autor, le methodo ha rendite possibile le obtention de un serie de 54 successose injectiones in 18 successive casos clinic sin mortalitate e sin morbiditate persistente e con grados minimal de disconforto pro le patientes.

Experience with Mammography in a Tumor Institution

Evaluation of 1,000 Studies[1]

ROBERT L. EGAN, M.D.

SOFT-TISSUE roentgenography of the breast is not new. In the American literature, Leborgne (4) of Uruguay described the technic of examination and the rogentenographic appearance of various mammary tumors. Warren (5) of the United States in 1929 reported on 119 cases, 58 of which were malignant. Interpretative errors were made in but 8 cases, 4 being in the malignant group. He stated: "In many of the cases, there was no unanimity of opinion in the preoperative clinical diagnosis. Several opinions were often held as to the presence of malignant or benign tumors in each case. The opinion from the roentgenogram, on the other hand, was often very definite and, most frequently, correct." Since Warren's publication an occasional enthusiastic proponent of this method of examination has appeared. However, as of the date of this study, no satisfactory statistical analysis of consecutive mammograms in patients with adequate follow-up has appeared in the American literature.

MATERIAL

One thousand consecutive x-ray examinations of the breast were performed at the M. D. Anderson Hospital and Tumor Institute in the period from May 1956 to May 1959. Adequate follow-up to date has been available on all except 2 patients. These were excluded from the series as both were examined in the terminal stage of malignant lymphoma, and neither biopsy nor autopsy was obtained. Six hundred and thirty-four patients were examined. For simplicity of presentation of results, each breast was considered a separate study. Frequently there was a lesion, benign or malignant, on each side, possibly with only 1 correctly diagnosed; or the patient may have had a previous mastectomy, leaving only one breast for study.

Not all patients admitted to the Hospital's breast service were referred for mammography. During the three-year period 1,253 new patients with lesions subsequently proved by biopsy were seen at that clinic, and of these, 956 had malignant and 297 had benign lesions. Cases of a questionable or palpable nodule in the breast, an inverted nipple, or nipple discharge were referred for mammography. Occasionally breasts were normal to palpation even though there was undifferentiated carcinoma in the axillary nodes or osseous lesions resembling metastatic carcinoma of the breast. Breasts containing clinically obvious carcinoma or with a known diagnosis of carcinoma following recent biopsy were not studied. The opposite breast was examined when such a patient was referred for mammography, however. If the result of the previous biopsy was not stated on the request for roentgenography, both breasts were radiographed.

ROENTGENOGRAPHIC TECHNIC

Positioning of the patient is illustrated in Figures 1–3. One roentgenogram of the axilla is obtained and two of the breast, in 2 planes at right angles. These have resulted in good delineation of the quadrants, ease in positioning, and patient comfort with consequent cooperation. The entire breast is positioned on a pliable cardboard holder which may be placed to follow the contour of the chest wall in the oblique position, thus covering the smallest gland. "Kodak Industrial M" film is used. The range of technical factors is shown in Table I. Usually the only variable is the distance necessary to include the entire breast on the roentgenogram. In general, 26 kv

[1] From the Department of Radiology, The University of Texas, M. D. Anderson Hospital and Tumor Institute, Houston, Texas. Accepted for publication in May 1960.

Fig. 1. Positioning for the cranio-caudad view. Identification marker is kept on the axillary side of breast for localization of the mammary quadrant.
Fig. 2. Oblique or lateral position. The cardboard film-holder is supported on a small wood block.
Fig. 3. Axillary view. The central beam is centered to the apex of the axilla and also parallel to the retromammary space. This arm position provides maximum visualization of the axilla as it reduces the number of skin folds without superimposition of the scapula. Factors: 54 kv, 300 ma, 40 inches, three and a half seconds; in obese patients the distance is reduced to 30 in.

TABLE I: RANGE OF TECHNICAL FACTORS USED TO PRODUCE ROENTGENOGRAMS OF THE BREAST

Age Group, Breast Type	Technical Factors
I. Menopausal, average consistency	
Small	
Cranio-caudad projection	300 ma, 22 kv, 30 in., 6 sec.
Oblique projection	300 ma, 24 kv, 30 in., 6 sec.
Medium	
Cranio-caudad projection	300 ma, 26 kv, 36 in., 6 sec.
Oblique projection	300 ma, 28 kv, 36 in., 6 sec.
Large	
Cranio-caudad projection	300 ma, 26 kv, 40 in., 6 sec.
Oblique projection	300 ma, 28 kv, 40 in., 6 sec.
II. Postmenopausal	Average 2–4 kv less; if flabby and flat, 5 sec.
III. Premenopausal, 30- to 45-year age group	Same as menopausal if only residual glandular tissue; 2–4 kv added with firmer breasts
IV. Virginal type	Same as premenopausal firm breast, but because of usually smaller size, 26 to 30 in. covers breast; 32–34 kv occasionally required
V. Dense area	Distance reduced to 20 to 22 in.

for the cranio-caudad projection and 28 kv for the oblique view, with 300 ma and six seconds, will suffice. The decreased distance for the smaller breasts adds sufficient mas to penetrate the denser glands; the larger breasts containing more fat are less dense, and require less mas. Only inherent tube filtration is used.

This technic has been productive of satisfactory roentgenograms in the hands of both student and staff technicians. Repeat examinations are rare. In practice the examination is no more difficult than routine chest studies and the time involved is comparable to that of a routine cervical spine study.

Neither the large focal spot nor the long exposure causes appreciable loss of detail. Use of a single fine-grain intensifying screen preserves most of the detail but with the addition of a second fine-grain screen soft-tissue detail is sacrificed. This is in contrast to the technics of higher kilvoltage, fast intensifying screens, and coarse-grain film advocated in the American literature (1, 3).

At these kilovoltage ranges, true mas was not obtained due to electron fog at the tube filament. The usual diagnostic x-ray machine does not have compensatory filament voltage regulation below 40 kv. Kilovoltage settings below 30 kv actually produce film characteristics more in keeping with the changes in mas than with the quality of the x-rays reaching the film.

The amount of radiation to the eye, skin, or gonads could not be calculated; actual measurements had to be made. In the

cranio-caudad position the film-holder was placed over a lead shield to protect against possible gonadal radiation. Patient exposure was found to be negligible.

The aluminum wedge may be used to transfer technical factors from one x-ray unit to another. At a distance of 36 inches, and with employment of a cone, type "M" film in a cardboard holder, and 300 ma at six seconds, the kilovoltage is varied until 15 mm. of aluminum is just faintly penetrated. This kilovoltage setting may then be used as the average and changed accordingly.

STATISTICAL METHODS

When it was decided to set up a technic for soft-tissue roentgenography of the breast in our department we felt we should be as objective as possible in the interpretation of the examination and rely entirely upon the roentgenograms without benefit of history or physical findings. The report of each study would include the absence or presence of a lesion and an opinion as to its benignity or malignancy. The diagnosis would be designated by a specific code symbol so that in review no confusion would arise as to the original conclusion. In such a system, there would be no provision for indeterminate studies. The single most important diagnosis was used in tabulation of the results even though more than one pathologic entity was present in the same breast.

All patients having mammography were examined in the breast clinic and most of them have been followed by periodic examinations there. A few, referred for consultation only, had follow-up reports from the referring physicians in their charts, giving either the final pathologic diagnosis or the results of periodic examinations. The clinical diagnosis of fibrocystic disease has been substantiated by aspiration of a cyst in many instances. Papanicolaou studies were routinely made on all patients with nipple discharge.

The follow-up span on all patients varied from six months to three and a half years, including the 361 whose examinations were read as negative. In none of these cases did breast carcinoma subsequently develop within the follow-up period.

The pathologist's most recent opinion on the breast biopsy tissue, the radical mastectomy specimen, or the postmortem findings was used as the diagnosis in each case. In the absence of a biopsy, those lesions diagnosed as benign have been considered verified by typical roentgenologic and physical findings which have remained constant on follow-up examinations.

ROENTGEN DIAGNOSIS

The important diagnostic signs in soft-tissue roentgenography of the breast have been lucidly described by Leborgne (4). He reported calcification in malignant mammary neoplasms and described "scattering . . . of innumerable punctate calcifications resembling fine grains of salt . . . . in and surrounding the nodule."

These flecks, referred to as calcifications from their appearance on the roentgenograms, do not all take calcium stains, and may be partly due to detritus in the tumor. The percentage of cases in which they were demonstrated was, in part, proportional to the quality of the roentgenogram. Calcium or not, their presence is practically pathognomonic of carcinoma, and they were observed in 118 of the 245 cases of carcinoma in our series. Coarser and denser types of calcification were found only in benign conditions such as fibroadenoma, plasma-cell mastitis, calcifying cysts, or arteriosclerosis.

The benign breast masses were homogeneously dense, rounded or smoothly lobulated, and surrounded by a thin radiolucent layer of fat. They pushed normal tissue aside and produced only local changes. The malignant tumors were denser in the center, had irregular spiculated borders, invaded nearby tissue, and were usually associated with some secondary changes in the breast: localized or diffuse skin thickening, nipple retraction venous engorgement, or involvement of axillary nodes. Diffuse thickening of the skin was a reliable sign of carcinoma.

TABLE II: DIAGNOSES IN 1,000 CONSECUTIVE MAMMOGRAPHIC STUDIES AS REPORTED AND CODED FROM MAY 1956 TO MAY 1959*
("Clinically negative" indicates breasts normal to palpation)

	Total	Coded as Benign	Coded as Negative	Coded as Malignant	Clinically Negative
Malignant lesion	245	0	7	238	19
Benign lesion; biopsy	182	162	0	20	0
No lesion; biopsy	4	0	4	0	0
Benign lesion; no biopsy	248	248	0	0	...
No lesion; no biopsy	321	0	321	0	321

* This is primarily a statistical review. Since preservation of adequate detail is difficult, no reproductions of roentgenograms are included.

RESULTS

The 1,000 studies were grouped as shown in Table II. The 7 cases of malignant disease coded as negative included 5 patients whose tumor was removed at the time of biopsy prior to admission, with no residual carcinoma being found in the postirradiated radical mastectomy specimen; 1 patient with a tumor in the tail of the breast not demonstrated on the roentgenograms as this was prior to the use of the axillary view; 1 patient with a small parasternal carcinoma that was not projected on the roentgenograms. Considering only the malignant lesions, the definite error in diagnosis by roentgenography was only 2 out of 240, or 0.83 per cent. Malignant tumors were found in 19 breasts clinically considered to be negative.

The benign lesions were diagnosed as indicated in Table III. Five small fibroadenomas in fibrocystic disease were overlooked; these were considered errors in diagnosis, with fibroadenoma used as the primary diagnosis.

DIFFICULTIES, SOURCES OF ERROR, OBSERVATIONS

Roentgenographic technics for soft-tissue study of most areas of the body are critical. This is not true of the breast where contrast of fat and surrounding structures exists and the paramount aim is detail rather than contrast. There is, however, variability of contrast due to factors of age, size of breast, state of nutrition, pregnancy, lactation, time in menstrual cycle, and the wide range of other normal physiological cyclic changes as well as abnormal processes.

In late pregnancy or lactation, or in the larger and denser virginal type of breast, the roentgenograms tend to be of poorer quality due to the higher kilovoltage required for penetration. For a diagnosis of carcinoma in these dense breasts, the tumor must be large or secondary signs of malignant disease must be present. Although not encountered in this study, a small carcinoma may be overlooked under such circumstances.

The roentgenogram must be obtained with the nipple in profile, otherwise nipple retraction cannot be evaluated.

TABLE III: FREQUENCY OF THE VARIOUS BENIGN CONDITIONS ENCOUNTERED IN 1,000 MAMMOGRAMS FROM MAY 1956 TO MAY 1959, TOGETHER WITH THEIR DIAGNOSIS BY MAMMOGRAPHY AND THE LESIONS MORE COMMONLY CONFUSED WITH CARCINOMA

		Total	Correct X-Ray Diagnosis	Coded as Malignant
Benign lesions with biopsy	Fibrocystic disease	102	99	3
	Fibroadenoma*	36	30	1
	Abscess	16	8	8
	Sclerosing adenosis	9	5	4
	Dilated ducts	4	4	0
	Intraductal papilloma	4	2	2
	Benign fibrosis	2	1	1
	Sebaceous cyst	2	2	0
	Cystosarcoma phylloides	3	3	0
	Scleroderma morphea	1	1	0
	Ectopic breast	1	1	0
	Granulomatous tissue	1	0	1
	Granular-cell myoblastoma	1	1	0
Benign lesions without biopsy	Fibrocystic disease	240	240	..
	Plasma-cell mastitis	4	4	..
	Fibroadenoma	4	4	..
TOTAL		430	405	20

* Five fibroadenomas in fibrocystic disease were overlooked.

The false positives, benign processes called malignant, were the greatest source of error in this series. These lesions included abscesses, infected cysts, or fibrocystic disease associated with marked sclerosing adenosis and/or ductal hyperplasia. In a review of these cases, the presence of carcinoma could not be definitely excluded by roentgenography. These are the lesions that would comprise the indeterminate group and, unfortunately, they were also considered malignant clinically; in at least 2 cases biopsies were performed three times.

Another difficulty encountered with fibrocystic disease, as already indicated, was the presence of a small fibroadenoma that was overlooked or considered a part of the fibrocystic process. This was an incidental finding at biopsy. Dilated ducts and intraductal papillomas were frequently similar in appearance; however, the treatment was the same: local excision to control bleeding. The single case of scleroderma morphea was reported merely as benign localized skin thickening, and a granular-cell myoblastoma was also coded only as a benign lesion. Sebaceous or intradermal cysts were readily identified by their relationship to the skin; in accessible areas nevi were clearly shown without extension into the subcutaneous fat.

No comparison could be made with palpatory diagnosis as the clinicians frequently disagreed as to the diagnosis or withheld it with the simple remark "biopsy, frozen section, and, if positive, radical mastectomy." However, subjection of a patient to general anesthesia for diagnosis indicated a strong clinical impression of malignancy.

No attempt was made to record the incidence of primary lesions in both breasts since metastasis *versus* second primary is a difficult problem. The first case of metastatic melanoma to the breast was a single lesion and was coded as carcinoma; however, the second case with multiple lesions in both breasts was recognized and correctly diagnosed as metastatic disease in a patient known to have melanoma. Mucinous adenocarcinoma, although not as aggressive-appearing as other malignant tumors, revealed sufficient changes for a diagnosis of carcinoma. Two cases of cystosarcoma phylloides were coded malignant purely on the basis of size, that being the only difference in appearance from the fibroadenoma or "giant fibroadenoma." Three other cases of cystosarcoma phylloides were coded as benign. The liberty was taken to leave these lesions as such in the tables since the pathologic diagnosis was on the basis of cell morphology rather than invasiveness of the tumor.

Postoperative changes following a biopsy for benign disease vaguely resembled localized carcinoma, without calcification or definite secondary signs of malignancy. In the absence of infectious complications, the mammogram reverted to a normal appearance in seven to ten days. Although many patients dated the onset of a breast nodule from trauma, no calcifying hematoma was encountered.

Usually in the breast with a previous biopsy for carcinoma, residual tumor or secondary signs of cancer were present and the diagnosis of carcinoma was readily made. The mammograms were obtained two to four weeks following the biopsy. The 5 cases with previous tumorectomy and normal mammograms were not considered unusual, however, as in these early lesions, following biopsy, the radical mastectomy specimen is often negative for residual carcinoma. These 5 patients did receive preoperative irradiation.

Of 4 cases of Paget's disease of the nipple, the underlying carcinoma was not detected clinically in 3, but was diagnosed by x-ray examination in all. Although the masses were not palpable, they could not be included with the unsuspected lesions, since the nipple changes reflected the presence of carcinoma clinically. In 1 of these cases, the nipple changes—slight elevation of 1 to 2 mm. and localized discoloration—were not roentgenographically apparent.

The smallest carcinoma demonstrated by roentgen rays was 8 mm. in diameter on sectioning. The presence of stippled cal-

cification led to the diagnosis. In the same breast the existence of a 4-mm. uncalcified nodule in a background of sclerosing adenosis was appreciated, although its malignant character was not. Small carcinomas in sclerosing adenosis were detected by the presence of calcifications; without such evidence, early malignant change cannot be recognized. With demonstrable calcification, the radiologist may be more definite than the surgeon in deciding which nodule should be biopsied or than the pathologist in deciding the question of malignancy *versus* benignity.

The demonstration of axillary nodes by roentgenography has some significance, but their finding is not a diagnostic criterion of malignancy. In 108 cases nonirradiated radical mastectomy specimens were available for pathologic study; axillary nodes were demonstrated by roentgen rays and found to be carcinomatous upon histopathologic study in 88. In 15 other cases microscopic carcinomas which had not been reported were present in axillary nodes, nearly all being less than 1 cm. in diameter. In 5 cases, however, noncarcinomatous nodes had been noted on the roentgenogram.

Despite these difficulties, the average study was simply obtained and readily interpreted. This is contrary to the views of the European authors who have stressed meticulous attention to technical details and special interpretative skills.

DISCUSSION

Soft-tissue roentgenography of the breast can be definitive in the diagnosis of malignant, benign, and normal conditions. Provision must be made for indeterminate studies and is just as necessary and valid for the radiologist as for the pathologist. Clinical judgment is mandatory but the typical carcinoma on a roentgenogram should not be ignored. The time-honored approach of palpation of a breast lesion followed by a decision to observe or prepare the patient for immediate radical mastectomy is necessary and well appreciated. While roentgenography has not established the absolute preoperative diagnosis, its use and refinement should substantially reduce the preoperative diagnostic errors. At times the radiologist may express an opinion contrary to that of the surgeon and on occasion may find it necessary to challenge the pathologist's interpretation of a breast lesion.

In this group of patients, were mammography used as a guide to definitive treatment, no carcinoma would have been overlooked except the 2 not projected onto the films. (At the time of roentgenography, if the location of the palpable nodule in the breast is known, such errors should be preventable.) One hundred and sixty-six general anesthesias would have been avoided and only 20 patients with benign disease would have been prepared for radical mastectomy. It could not be determined in the review of numerous other benign lesions whether the radiologist's report influenced the clinical decision to omit biopsy. In no instance where a lesion was described on the x-ray report was the patient found to have a normal breast.

CONCLUSIONS

The palpatory method of detection and diagnosis of breast lesions is inaccurate even in an institution where a limited number of clinicians evaluate all patients attending the breast clinic, numbering 2,430 yearly. Soft-tissue roentgenography of the breast can reduce the error of preoperative diagnosis and reveal a number of unsuspected lesions. In addition, it can obviate a significant number of general anesthesias now administered for diagnostic purposes. Experience has shown mammography to be a simple method of demonstration of a breast lesion with a high accuracy in prediction of its type. Analysis of the value of soft-tissue roentgenography in our institution has indicated its reliability as a diagnostic tool.

SUMMARY

1. The roentgenographic interpretations, without benefit of history or clinical

findings, of 1,000 consecutive soft-tissue examinations of the breast are given.

2. A simple radiographic technic, based on changing the one variable of distance, is explained.

3. With roentgenograms of sufficient detail, any radiologist with the average physician's knowledge of the anatomy and pathological processes of the breast can diagnose breast lesions with a high degree of accuracy.

4. Experience with this simple examination in our institution has indicated its reliability as a diagnostic tool, with an error of less than 1 per cent in malignant disease.

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Texas Medical Center
Houston 25, Texas

SUMMARIO IN INTERLINGUA

Experientias con Mammographia in un Institution pro Tumores

Mille consecutive roentgeno-examines del mamma esseva effectuate in 634 patientes inter maio 1956 e maio 1959. Le serie non include casos de obvie carcinoma o de carcinoma cognoscite per recente biopsias.

Un roentgnogramma esseva obtenite ab le axilla e 3 ab le mamma, in 2 planos a angulo recte. Un dispersion de innumerabile punctos de calcification, resimilante granos fin de sal, in e circum un nodulo tumoric indica malignitate. Plus grossier e plus dense typos de calcification esseva trovate solmente in conditiones benigne: in fibroadenoma, mastitis plasmocytic, cystes calcificante, o arteriosclerosis. Benigne massas mammari esseva homogeneemente dense, ronde o lisiemente lobulate, e circumdate de un tenue strato de grassia radiolucente. Illos retroprimeva tissu normal e esseva responsabile solmente pro alterationes local. Maligne tumores esseva responsabile solmente pro alterationes local. Maligne tumores esseva plus dense in le centro; illos habeva spiculate margines irregular, invadeva le tissu adjacente, e esseva usualmente associate con le un o le altere lesion secundari in le mamma.

Super le base de constatationes roentgenologic sol, 238 ex 245 canceres del mamma esseva registrate como maligne. In 5 del non assi registrate casos de cancere, le tumor esseva removite al tempore del biopsia ante le hospitalisation, e nulle residue carcinoma esseva trovate in le specimen del post-irradiatori mastectomia radical. In 2 casos le examinator non habeva essite informate del location probabile del tumor, e isto non esseva projicite in le roentgenogramma. Omne le lesiones benigne, con solmente 20 exceptiones, esseva registrate como tales. Si nos considera solmente le neoplasmas maligne, le error definite in le diagnose per roentgenographia esseva 2 ex 240 o 0,83 pro cento. Maligne tumores esseva trovate in 19 mammas considerate, a base clinic, como negative. Nulle mamma esseva trovate normal pro le qual le reporto radiologic describeva un lesion.

Difficultates e fontes de error es discutite detaliatemente.

Primary Mediastinal Choriocarcinoma[1]

BERNARD S. YURICK, M.D.,[2] and RICHARD E. OTTOMAN, M.D.

PRIMARY extragenital choriocarcinoma is a rare tumor. Magovern and Blades in 1958 (1) collected 25 cases from the literature, of which 11 were situated in the mediastinum (Table I). The case to be reported in this article is believed to be the twelfth.[3]

The rarity of this tumor stimulated a survey of the literature and 7 cases reported in the English language were reviewed in the effort to discover some conclusions regarding etiology, diagnosis, therapy, and prognosis.

TABLE I: SUMMARY OF REPORTED CASES OF PRIMARY MEDIASTINAL CHORIOCARCINOMA

Author	Date	Age and Sex	Gynecomastia	Pregnancy Test	Histology	
					Primary	Metastasis
Arendt (18)*	1931	20 M	Yes	...	...	...
Kantrowitz (17)	1932	22 M	No	Positive	Complex teratoma and choriocarcinoma	Choriocarcinoma
Laipply and Shipley (12)	1945	13 M	Yes	Positive	Complex teratoma and choriocarcinoma	Choriocarcinoma
Hirsch, Robbins, and Houghton (11)	1946	26 M	Yes	Positive	Undifferentiated cells and choriocarcinoma	Choriocarcinoma
Giroux and Desmeules (19)*	1947	12 M	No	Positive	Chorioepithelioma in a dysembryoma	Choriocarcinoma
Shlimovitz and Van Brown (14)	1950	27 M	Yes	Positive	Complex teratoma and choriocarcinoma	Choriocarcinoma
Zorzi and Piacenti (20)*	1952	29 M	Yes	Positive	...	...
Nielubszyc (21)*	1952	38 M	Yes	Positive	...	...
Fanger and MacAndrew (16)	1952	44 F	...	...	Complex teratoma and choriocarcinoma	Granulomatous lesions typical of tuberculosis in liver and mediastinal nodes
Lynch and Blewett (10)	1953	26 M	Yes	...	Choriocarcinoma	Choriocarcinoma
Magovern and Blades (1)	1958	20 M	?	Positive at autopsy	Seminoma, embryonal cell cancer, choriocarcinoma	Choriocarcinoma
Ottoman and Yurick	1959	26 M	No	...	Choriocarcinoma	Choriocarcinoma

* Cases abstracted from Magovern and Blades (1).

CASE REPORT

J.W., a 26-year-old white married truck driver, was first seen in the Outpatient Department of the University of California at Los Angeles Medical Center on July 29, 1955, with a chief complaint of right-sided chest pain of four months duration. It had first come to his attention in April, subsequent to a minor motorcycle accident and the strain of lifting a bathtub onto a truck, both injuries being considered trivial. The pain was situated in the third intercostal space just to the right of the sternum, was rather severe for two to three weeks, and then gradually disappeared. Recurrence one week later was accompanied by pain in the right shoulder and in the back of the neck. There had been one episode of paresthesia involving the right hand and lower lip. Heat treatments had been administered by two physicians whom he had consulted, without results. A chest roentgenogram obtained in a doctor's office demonstrated an abnormal density in the right thorax. This was interpreted as an aortic aneurysm. While the patient had had contact with potential syphilitic carriers, his spinal fluid and blood serology were negative. A chest film made a year earlier was reported normal.

Initial physical examination revealed a well developed, well nourished white male in no distress. A few nontender nodes were present in the cervical, axillary, and inguinal areas. The liver was palpable

[1] From the Department of Radiology, University of California School of Medicine, Los Angeles, Calif. Accepted for publication in May 1960.

[2] Present address: United States Naval Hospital, San Diego, Calif.

[3] The report of a similar case recently observed at the Henry Ford Hospital has been submitted for publication elsewhere.—*Editor.*

Figs. 1 and 2. Postero-anterior and lateral roentgenograms of the chest on the initial visit, Aug. 3, 1955. The anterior mediastinal mass protrudes into the right lung field, although it is sharply outlined and there is no displacement of mediastinal structures.

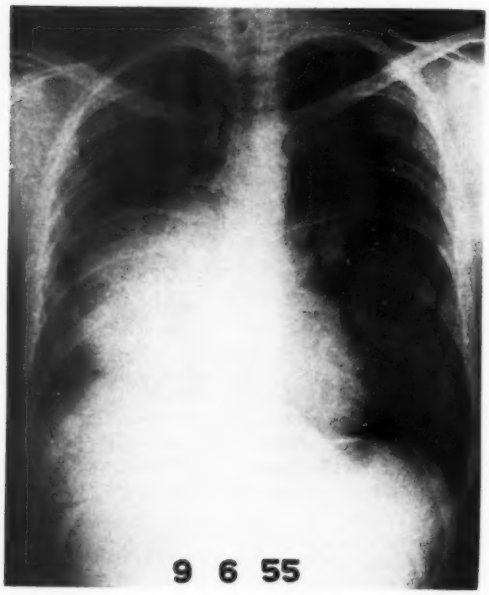
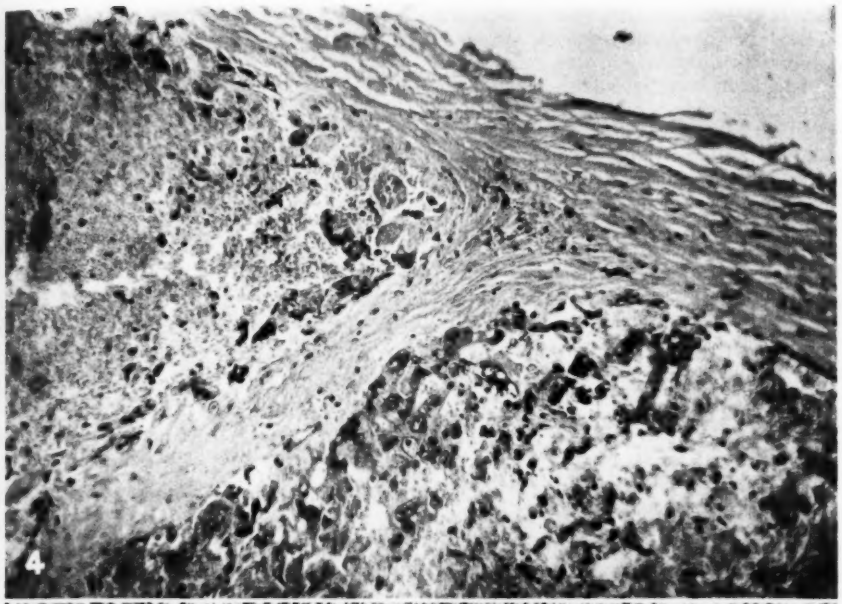


Fig. 3. Follow-up postero-anterior chest roentgenogram, Sept. 6, showing the doubling in size of the mass in one month.

two fingerbreadths below the right costal margin and the spleen was questionably palpable. There was left rib margin tenderness, but the chest examination was otherwise negative. There was no gynecomastia.

Chest films obtained Aug. 3 (Figs. 1 and 2) showed a well demarcated anterior mediastinal mass. This was interpreted as a cyst, possibly an intrathoracic extension of a reduplication of the foregut. The patient was now complaining of dyspnea and neck pain. He was scheduled for admission and exploration but these were cancelled because a cold developed. A repeat roentgenogram on Sept. 6 (Fig. 3) revealed the mass to have doubled in size since the previous examination, and lymphosarcoma and malignant thymoma were now considered the best diagnostic possibilities. The patient had had several bouts of hemoptysis in the preceding three weeks and at this time complained of exertional dyspnea, orthopnea, malaise, and a 20-lb. weight loss in the past three months.

A left axillary lymph-node biopsy on Sept. 12 showed the nodes to be benign. Exploratory thoracotomy on Sept. 15 revealed a grapefruit-sized mass in the anterior mediastinum, compressing the right middle lobe and superior vena cava. Biopsy demonstrated extensive necrosis within the tumor, and a diagnosis of anaplastic malignant tumor was made. Cobalt teletherapy to the mediastinum was begun on Sept. 16, and the patient received 4,705 r tumor dose in forty days. The neoplasm increased in size during treatment. Symptoms of superior vena cava obstruction developed, and to relieve these cobalt teletherapy was given higher in the mediastinum, but without success. The patient's condition con-



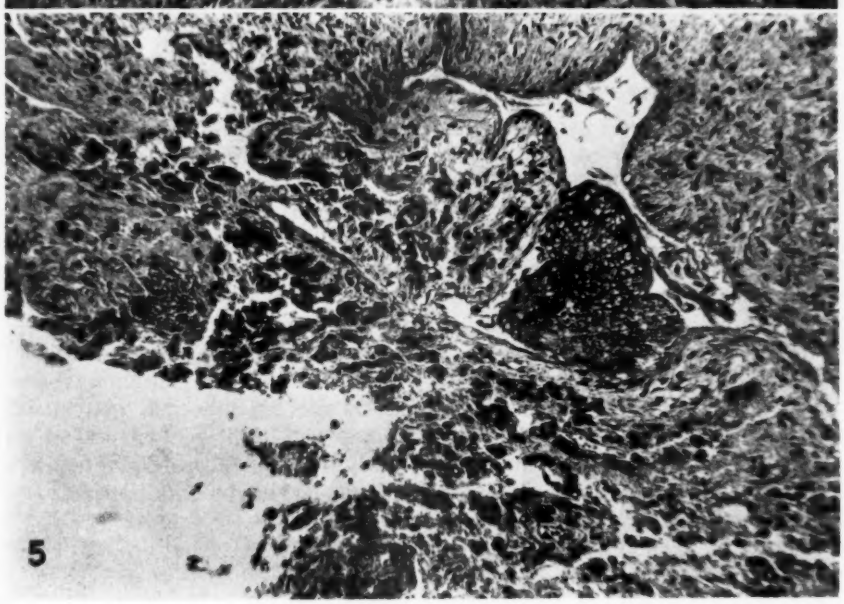


Fig. 4. Section of mediastinal tumor showing fibrous capsule lined with trophoblastic elements. The more central portions of the tumor show extensive necrosis × 80.

Fig. 5. Section of right lung contiguous with the tumor, showing invasion by trophoblastic cells. Note the venous channel with organized clot, a portion of which is being invaded by the tumor. ×80.

tinued to deteriorate rapidly and he died Nov. 4, six months following the onset of his initial symptoms.

Autopsy: Positive findings at autopsy were limited to the mediastinum, right lung, liver, spleen, and testicles. There was no evidence of gynecomastia. No biological studies were made. The mediastinal mass, which measured 16.5 × 17.0 × 9.0 cm., compressed the right middle and lower lobes and involved the superior vena cava, causing partial obstruction of this vessel. It was adherent to the

undersurface of the sternum, ribs, and mediastinal pleura. There was a fine, fibrous capsule surrounding the tumor which, on section, was found to be composed of markedly necrotic, reddish-brown tissue with numerous areas of hemorrhage as well as small cystic areas containing thick brownish fluid. The spleen weighed 1,550 grams and was diffusely infiltrated with yellowish-white tissue. The liver weighed 3,000 grams and was similarly infiltrated with yellowish tissue. The testes, although small, were normal on cross section.

Microscopically, the tumor was composed of two cell types, a round cell resembling cytotrophoblast and a large multinucleated giant cell resembling syncytiotrophoblast. The neoplasm was invading the blood vessels and showed extensive necrosis (Fig. 4). The liver, spleen, and contiguous areas of the right lung were diffusely infiltrated with tumor composed of the cell types listed above (Fig. 5). No differentiated teratoid structures of embryonal cell elements were identified. The testes were examined with multiple gross and microscopic sections and showed no evidence of tumor or scar. The tubules were atrophic and spermatogenesis was diminished. There was moderate hyperplasia of the interstitial cells. The anterior pituitary gland showed no abnormalities.

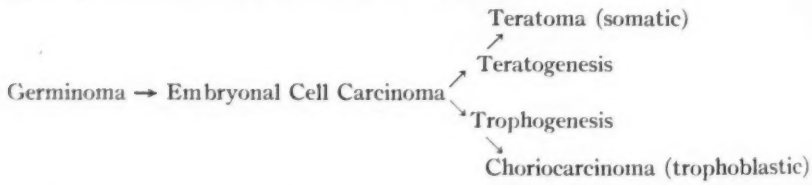
DISCUSSION

Miller and Browne (2) list four theories that have been advanced to explain the occurrence of extragenital teratomas: (*a*) included twin theory, (*b*) included zygote theory, (*c*) somatic cell rests, (*d*) primitive germ-cell rests. The first three theories have been largely discounted. The fourth theory is the most quoted in recent literature and appears the most acceptable.

The origin of the primitive germ cells is the subject of a dispute which is by no means settled. Arey (3) and Patten (4) both state that two theories regarding their origin have been postulated. One sets forth that they arise from the mesothelial covering of the primitive gonad, the so-called germinal epithelia. The other theory purports their origin to be in the yolk sac entoderm and claims that the cells reach the gonad by migrating along the urogenital ridge. Since this ridge extends from C-6 and L-3 abnormal inclusions along it would explain the occurrence of teratomas in the mediastinum, peritoneal organs, and retroperitoneum. It would also seem possible that these cells might remain dormant (as they do in the gonad) until puberty or later sexual life when some stimulus might cause them to maturate and differentiate. This would explain their occurrence in the third decade of all but one of the cases reviewed here. If teratomas are to be produced by stimulation of primitive germ cells, we must assume a parthenogenetic segmentation of an unfertilized gamete. This has been observed in many lower animals, including the ovary of the rat. There is no reason to assume that it might not occur in man.

Friedman (5) believes that mediastinal teratomas arise from germ-cell rests in the anlagen of the thymus gland. This belief has also been advanced by Schlumberger (6) after a review of mediastinal teratomas. Iverson (7), however, states that thymic tumors sometimes present histologic features similar to those of seminomas but considers that differences exist which would allow differentiation between thymic and germinal tumors. He believes that there is no connection between thymoma and teratoma of the mediastinum.

Friedman has suggested a scheme for the histogenesis of these tumors based on a study of testicular and extragenital teratomas and their metastases. By careful study of both the primary tumor and the metastasis he was able to arrive at the following:



The germinoma is considered the primary tumor resulting from the division of the primitive germ cell. This differentiates to the embryonal cell stage, and goes on

from that point in either one or both of two directions, ending in teratomatous structures on one hand and trophoblastic tissue on the other. The presence of teratomatous and trophoblastic structures in the same tumor without evidence of embryonal cell carcinoma led him to believe that this intermediate stage may be skipped in some cases. The theory readily explains the preponderance of mixed tumors among the 7 cases reviewed. The case herein reported was pure choriocarcinoma both in the primary site and in the metastases.

Prym's (8) case report in 1927 caused some concern over the validity of extragenital choriocarcinoma. Finding a scar in the testicle in a supposed case of retroperitoneal choriocarcinoma, he deduced that the primary tumor in the testicle had undergone involution and that the retroperitoneal mass represented a metastasis. Since that time, standards have become more strict, multiple sections of both testicles being required to rule out scars or small tumors. Most authors agree that choriocarcinoma of the testicle can spontaneously regress. Rottino and DeBellis (9) reported a case of extragenital choriocarcinoma in which a testicular scar was found. In the vicinity of the scar were some teratomatous vestiges, but no malignant tissue. They believed that the choriocarcinoma represented a metastasis from a previously active malignant testicular teratoma. Lynch and Blewett (10) cite Grieling's series of 220 metastasizing testicular tumors in which there was not one instance of anterior mediastinal metastasis. The number of cases accepted as true extragenital choriocarcinoma in several papers varied with the rigidity of criteria used to rule out testicular tumors. Some authors (10, 11) consider that multiple sections of the testicle are sufficient, while others (12, 13) believe that serial block sections should be made along with hormone studies of the tumor tissue. We believe that careful gross sectioning with multiple microscopic sections is sufficient to rule out tumors or scars of the testicle. Lynch and Blewett state that no one had considered that the testicular scar might be the result of the primary extragenital tumor. They further believe that intense hormonal stimulation may cause the totipotent cells in the gonad to undergo teratomatous change. Trauma also cannot be overlooked as a cause of testicular scarring.

Symptoms: The most common symptoms of mediastinal choriocarcinoma are chest pain followed by cough, hemoptysis, and dyspnea. Later signs are weight loss, anorexia, and generalized malaise. One case presented with abdominal pain as a primary symptom; this was due to liver metastases from an occult mediastinal choriocarcinoma (14). The pain is characteristic of tumor in the anterior mediastinum but is certainly not pathognomonic of choriocarcinoma. It is usually referred to the upper chest wall anteriorly in the region of the nipple. Radiation of pain to the neck, shoulders, and arms may occur. Gynecomastia was present in 3 out of 7 cases reviewed and questionable in a fourth. This sign was not exhibited in our case. The presence of the triad of chest wall pain, cough, and gynecomastia in a male between the ages of twenty and thirty years, with a mediastinal mass revealed on chest examination, should strongly suggest this tumor.

Radiological Signs: A choriocarcinoma usually presents as a well defined anterior mediastinal density. The trachea and mediastinal structures may be shifted, although the tumor may grow around them without significant displacement. Rapid growth is a clue to the markedly malignant nature of the process. Although necrosis typically occurs, there is no mention of cavitation in the x-ray reports of the cases reviewed. Figures 1–3 illustrate the typical findings.

Treatment and Prognosis: No method of treatment has been successful in the management of mediastinal choriocarcinoma. All cases terminated fatally within four weeks to six months. Table II records the prognosis in the cases reviewed. The only apparent discrepancy

TABLE II: PROGNOSIS OF MEDIASTINAL CHORIOCARCINOMA

Author	Onset of Symptoms to Death
Kantrowitz (17)	15 months
Laipply and Shipley (12)	7 years*
Hirsch, Robbins, and Houghton (11)	4 weeks
Shlimovitz and Van Brown (14)	5 weeks
Fanger and MacAndrew (16)	6 weeks
Lynch and Blewett (10)	6 weeks
Magovern and Blades (1)	5 months
Ottoman and Yurick	6 months

* A benign teratoma was found at the age of thirteen in this patient; the cancer was discovered at a routine chest examination six and a half years later, or six months before death.

is the case of Laipply and Shipley (12), which was discovered at the age of thirteen and covered a span of seven years. The original tumor, however, was a benign teratoma and cancer was found six and a half years later on a routine chest examination. The patient lived six months from the time of his second chest roentgenogram until death.

Surgical treatment has been generally unsuccessful, due to the rapidity of growth and the widely invasive characteristics of this tumor. Roentgen therapy has also been of little help. Laipply and Shipley reported growth of the tumor in spite of deep therapy. Similar results were observed with cobalt-60 teletherapy in our case. In a recent study, 6 females and 5 males were treated chemotherapeutically for choriocarcinoma (15). All of the female patients showed a marked drop in gonadotropin titer following treatment with Methotrexate and 6-mercaptopurine. Only minor fluctuations of gonadotropin titer occurred in the male patients, and these bore no relation to therapy. Orchidectomy was performed on the males and large doses of estrogen were administered in an attempt to alter the hormonal background. There was still no response to Methotrexate or 6-mercaptopurine. It was concluded that female tumors, in most cases, arise from the fetal and not from the maternal tissue. In the male, however, tumor arising in the gonad is truly autogenous and perhaps less susceptible to destructive influences. Any hope of cure probably resides with the development of newer chemotherapeutic drugs.

SUMMARY

A case of primary choriocarcinoma of the mediastinum is presented. This would appear to be the twelfth such case, and the second pure choriocarcinoma reported as primary in the mediastinum. The 7 cases reported in the English language have been reviewed as well as some facts concerning the etiology, diagnosis, treatment, and prognosis.

University of California Medical Center
Los Angeles 24, Calif.

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SUMMARIO IN INTERLINGUA

Primari Choriocarcinoma Mediastinal

Es reportate un caso de primari choriocarcinoma extragenital, presumitemente le dece-secunde a trovar in le litteratura. Le tumor duplava su dimension intra un mense post que le autores lo habeva primo vidite in un roentgenogramma. Le morte del patiente occurreva sex menses post le declaration del symptomas initial in despecto de un dosage de 4.705 r de teletherapia a cobalt administrate in quaranta dies. Al necropsia il esseva trovate que le massa mediastinal—mesurante 16,5 per 17,0 per 9,0 cm—comprimeva le lobos dextero-medial e inferior e afficeva le vena cave de maniera que iste vaso esseva partialmente obstruite. Le massa adhereva al subfacie del sterno, del costas, e del pleura mediastinal. Le testes, ben que micre, se monstrava normal in transsection. Hepate, splen, e adjacente tissus pulmonar monstrava diffuse infiltration tumoral.

Es revistate septe casos ab le litteratura anglese. Es opinate que teratomas extragenital prende lor origine in restos de primitive cellulas germinal. Le provenientia de istos es controverse. Le symptomas de choriocarcinoma mediastinal es dolores thoracic sequite per tusse, hemoptysis, e dyspnea. Le signos de declaration subsequente include perdita de peso, anorexia, e un generalisate malaise. Radiologicamente le tumor es un ben definite massa antero-mediastinal. Su rapide crescentia es un indicio de su maligne natura. Nulle methodo de tractamento ha succedite.

Whipple's Disease

Roentgenologic Findings, Including Those of an Eight-Year Remission[1]

STEFAN C. SCHATZKI, M.D.

WHIPPLE'S disease is a systemic condition characterized by diarrhea, intestinal malabsorption, abdominal pain, lymphadenopathy, and a polyarthritis, which may antedate the other symptoms by several years. In the first forty-two years after Whipple's original description of this disease in 1907 (10), only ten references to it could be found in the English literature, but more recently it has attracted a great deal of attention, and in the past decade it has been the subject of over fifty articles. Very little, however, has been written about the detailed radiologic features (3, 6, 8).

The present report is concerned with 3 cases of Whipple's disease, with special attention to the radiologic findings. One of these cases, originally published by Jones, Benson, and Roque (5), is of particular interest because of reversion of a grossly abnormal small-bowel roentgen picture to normal following administration of steroids and ACTH. The eight-year remission in this instance is the longest yet recorded. Only 2 other reports could be found in the literature with roentgenograms showing return of the small-bowel picture to normal following therapy (4, 9).

CASE REPORTS

CASE I: M. H., a 49-year-old female, was admitted to the hospital Sept. 19, 1951, with a probable diagnosis of sprue. Two years previously she had experienced a typical attack of rheumatoid arthritis. There was a history of intermittent epigastric pain for twenty years. This had become worse in the year before admission and had not improved following cholecystectomy. In the past four months the stools had become loose and foamy; lower abdominal pain, abdominal distention, and deepening pigmentation had developed, and there had been a weight loss of 25 pounds. On admission, the patient was emaciated, with a striking yellowish-brown pigmentation of the skin, most marked in the palmar creases. The hemoglobin was 9.0 grams and the red cells were microcytic. The serum calcium was 7.8 mg. per 100 ml., the albumin 3.1 grams per 100 ml., the globulin 1.8 grams per 100 ml., and the alkaline phosphatase 9.6 Bodansky units. The stool contained 23 grams of fat and 2.7 grams of nitrogen per twenty-four hours excretion. A gastrointestinal series (Fig. 1) showed the small bowel to be grossly abnormal, with marked thickening of the mucosal folds and minimal segmentation and flocculation.

Because of the severity of the symptoms, the patient was started on ACTH on Sept. 27, and within three days there was a marked improvement in appetite, gain of weight, and decrease in the number of stools. Ten days after the beginning of therapy the fecal fat had fallen to 15.8 grams and the fecal nitrogen to 1.9 grams a day. The serum calcium had risen to 9.6 mg. per 100 ml. On Oct. 7, the daily medication was changed to 100 mg. of cortisone orally.

On Oct. 16, three weeks after steroids were first administered, another small-bowel study was done (Fig. 2). Thickening of the small-bowel folds was still present, but flocculation and segmentation had disappeared. Because of acute abdominal pain, suggesting a perforated viscus, exploration was done one week after these films were obtained. At surgery, diffuse lymphadenopathy of the entire mesentery was noted. The bowel wall was thickened and the lymphatics were diffusely dilated, most markedly in the proximal portion of the small intestine. A biopsy of the small bowel (Fig. 3) established the diagnosis of Whipple's disease.

The patient did well postoperatively, and seven weeks after institution of therapy, the fecal fat and nitrogen had fallen to 5.5 and 1.7 grams, respectively, per twenty-four hours. The hemoglobin was 13 grams and the serum calcium 10.2 mg. per 100 ml. A small-bowel series (Fig. 4), in December, showed normal findings. Steroid administration was discontinued Dec. 31, 1951.

For the next five years the patient felt well and the abnormal pigmentation disappeared. In February 1957, and again in May, she complained of foul, gray stools for two days on each occasion. There were occasional bulky stools through 1958, and in January 1959 a severe attack of periumbilical pain occurred, with distention, leading to an enormous gray, foul, frothy bowel movement. Another small-bowel study, in February 1959 (Fig. 5) demonstrated findings felt to be probably within normal limits even though the mucosal folds of the proximal jejunum may have been at the upper limits of normal

[1] From the Department of Radiology, Massachusetts General Hospital, Boston, Mass. Accepted for publication in May 1960.

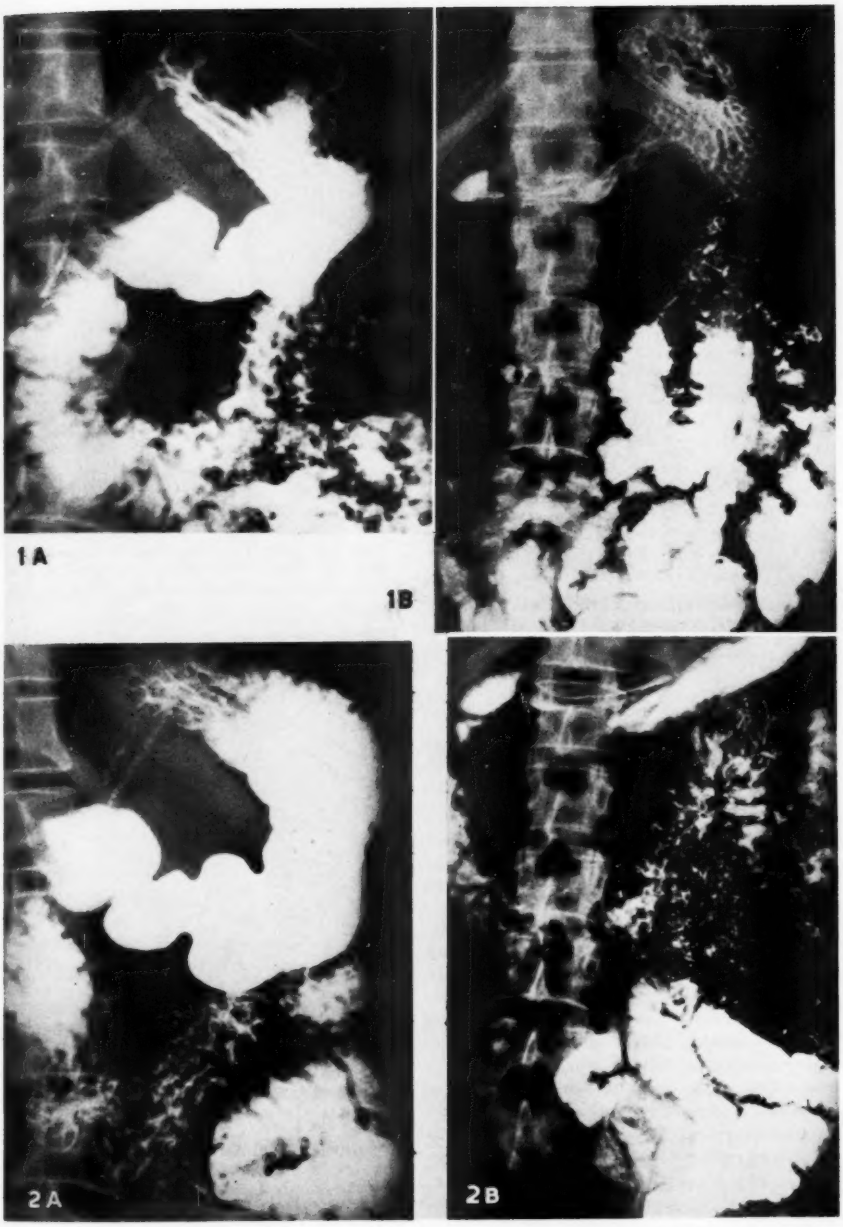

Fig. 1, A and B. Case I: Examination prior to therapy, showing marked thickening of the mucosal folds throughout the small bowel, most severe in the proximal intestine, and minimal flocculation and segmentation. The patient had severe symptoms and clinical malabsorption at this time.

Fig. 2, A and B. Case I: Examination three weeks after the beginning of steroid therapy. The small-bowel mucosal thickening is still present but flocculation and segmentation are no longer seen. The symptoms had diminished and there was definite improvement in the malabsorption by clinical criteria.

Fig. 3. Case I: Photomicrograph of the jejunum showing the marked mucosal infiltrate with large macrophages having granular cytoplasm which stained heavily with periodic acid Schiff stain but not with fat stains. The separation of the epithelium from the macrophages represents only preparation artefact.

in width. The patient had lost a little weight and there was increased pigmentation.

In the following ten months there were two attacks of cramps, with loose profuse stools, lasting one and one-half days. On Feb. 4, 1960, an upper jejunal biopsy with a transoral biopsy tube showed no evidence of Whipple's disease.

CASE II: A. M., a 34-year-old female, was admitted to the hospital with diarrhea of seven months duration. This had been especially severe for the past month, with foamy, watery, foul-smelling bowel movements. There had been a weight loss of 40 pounds. It is of interest that four years earlier the patient had suffered an attack of "rheumatic fever."

Physical examination on admission was negative except for diffuse lymphadenopathy and some increase in pigmentation. The hemoglobin was 8.7 grams and the red cells were normocytic and slightly hypochromic. The serum calcium was 8.2 mg. per 100 ml., the albumin 3.6 grams per 100 ml., and the globulin 2.5 grams per 100 ml. A prothrombin time of 32 per cent (other chemistry studies of the liver were normal), a serum carotene level of zero, and a five-hour D-xylose urinary excretion of 1.3 grams (6.5 grams normal) all indicated intestinal malabsorption. The stools, which were guaiac-positive, contained excessive fat. A small-bowel examination (Fig. 6) showed diffuse thickening of the mucosal folds with little other abnormality. Exploration because of the possible presence of a mass revealed thickening of the bowel wall and diffuse adenopathy in the mesentery, with the largest node measuring 5.4 cm. Biopsy showed the typical features of Whipple's disease.

Fig. 4. Case I: Examination three months after beginning of steroid administration. The small bowel was considered normal, and at this time the patient no longer had any symptoms.

Fig. 5. Case I: Examination seven years after cessation of steroid therapy. The small intestine was thought to be normal but the width of the mucosal folds of the proximal jejunum were at the upper limits of normal. Minimal symptoms were present at this time but there was no malabsorption.

The patient was readmitted several months later because of continuation of the bowel symptoms. At this time she was first placed on ACTH and later on cortisone (50–75 mg./day). She was able to be up and about for the following year. However, her

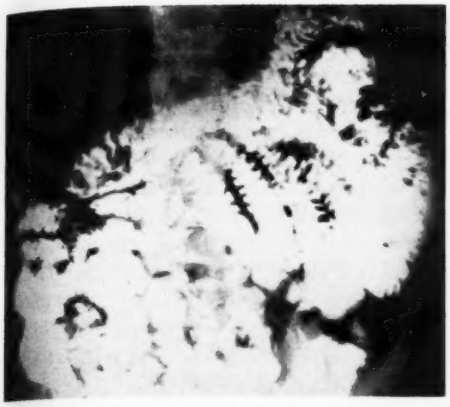

Fig. 6. Case II: Examination of a 34-year-old female prior to therapy. Marked and diffuse thickening of the small-bowel mucosal folds is seen, the changes, as in Case I, being most striking in the proximal intestine. No flocculation or segmentation is present. The patient had severe symptoms and clinical malabsorption at this time.

symptoms including weight loss continued. She was again hospitalized one year after the second admission, for symptoms suggesting hypocalcemia. The hemoglobin was 9.7 grams, and the serum calcium 4.8 mg. per 100 ml. Several episodes of hypocalcemic tetany occurred, with calcium levels of 5.4 and 5.2 mg. per 100 ml; and were treated with intravenous and oral calcium. The diarrhea became worse, a toxic psychosis developed, and death ensued March 25, 1958, sixteen months after the first admission to the hospital.

Postmortem studies revealed the following typical gross findings of Whipple's disease: marked thickening of the small-bowel mucosal folds; diffuse lymphadenitis with mesenteric nodes as large as 3 cm.; verrucous endocarditis of the aortic and mitral valves; adhesive pericarditis; polyserositis. Macrophages taking a positive periodic acid Schiff stain were found in most of the organs of the body, particularly in the small-bowel mucosa and in the enlarged lymph nodes.

CASE III: A. A., a 67-year-old male, first noted stiffness and decreased motion in his elbows and shoulders three to four years before admission to the hospital. For two years, there had been increasing diarrhea, with weight loss of 20 to 40 pounds. The patient had six to eight watery bowel movements per day, diffuse abdominal swelling, but no abdominal pain, and was extremely weak and emaciated. The abdomen was markedly distended. There were edema of the lower extremities, a diffuse increase in pigmentation, and generalized lymphadenopathy. The blood pressure was 90/60, the hemoglobin was 10.3 grams, the serum albumin 2.1 grams and the globulin 2.4 grams per 100 ml. A barium enema examination showed questionable widening of mucosal folds of the cecum, and a small-intestine examination

Fig. 7. Case III: Examination of a 67-year-old male prior to any therapy, showing marked segmentation and flocculation of barium in the small bowel. There was generalized dilatation of the small intestinal loops but the mucosal thickening was less striking than in Cases I and II. This film was obtained five and a half hours after ingestion of the barium which did not definitely reach the cecum for seven hours. The generalized hazy appearance of the abdomen and the widened spaces between bowel loops represent ascites. Severe symptoms with profound malabsorption were present at this time.

was grossly abnormal (Fig. 7). Thickening of the mucosal folds was noted, although it was not as striking as that described in Cases I and II. There was marked evidence of the so-called "malabsorption pattern," with flocculation of the barium, segmentation, and definite dilatation of the lower small-bowel loops. There also was a delayed transit time, the barium reaching the cecum after seven hours. Intestinal malabsorption was confirmed by the following laboratory data: serum calcium 7 mg. per 100 ml., serum carotene zero, serum vitamin A 0.16 units (0.3-1 unit normal), serum cholesterol 79 mg. per 100 ml., a five-hour urinary excretion of D-xylose of 0.7 gm. (6.5 grams normal), and a flat glucose tolerance curve. The stool contained 44 grams of fatty acids and 8.2 grams of nitrogen per day.

Axillary node biopsy had led originally to a diagnosis of chronic hyperplastic lymphadenitis, but a duodenal biopsy by means of an intraluminal tube passed transorally established the diagnosis of Whipple's disease. A review of the earlier lymph node slides showed the findings of Whipple's disease, with a positive periodic acid Schiff stain. Films of the shoulders and elbows failed to reveal any evi-

dence of abnormality, except for some minimal disuse atrophy.

Large doses of prednisone and prednisolone, 100 mg. per day, were administered, but the patient continued to do poorly with persistent diarrhea and failure to regain any weight. He died Nov. 7, 1959, two months after he was first seen. Postmortem studies were not obtained.

RADIOLOGIC FINDINGS

The recognized radiologic changes in the small bowel in Whipple's disease have been reported by Martel and Hodges (6), who also discussed the differential diagnosis. The changes are nonspecific and may be mimicked by a large number of other diseases, particularly sprue, lymphoma, and amyloid disease.

The striking finding in the 3 cases reported here was a marked thickening of the small-bowel mucosal folds. This was diffuse, involving particularly the duodenum and upper jejunum. In one case, there was questionable involvement of the cecum. This diffuse mucosal widening, which is expected from the pathological picture, may be seen throughout the small bowel without other changes of the so-called "malabsorption pattern." While prominence of the mucosa occurs in the other diseases mentioned above, its predominance in the proximal small bowel in the absence of the other changes of the "malabsorption pattern," should suggest Whipple's disease.

When such features of the "malabsorption pattern" as segmentation and flocculation of barium are seen, there is no specificity to the picture. Dilated loops of small bowel may occur, as in our Case III and a case reported by Martel and Hodges. The transit time may be normal or may be prolonged, as in Case III, where seven hours were required for the barium to reach the colon.

Case I is interesting in that a grossly abnormal small-bowel roentgen appearance, with marked mucosal thickening, flocculation, and minimal segmentation, returned to normal, with a clinical remission of the disease after a short period of therapy. The nonspecific "malabsorption pattern" returned to normal less than three weeks after the beginning of treatment, with thickening of the small-bowel folds the only remaining abnormality. This change was associated with an improvement in the laboratory criteria of intestinal absorption and a decrease in fatty acids in the stool. Such a rapid radiologic change may lend support to Marshak's (8) view that many of the features of what he terms the "sprue pattern" are related to the effects of elevated fatty acids on the small bowel. Three months following the initiation of steroids in our case, the small bowel appeared normal. This is of particular interest in comparison with sprue in which Marshak (7) describes the improvement in the small bowel radiologic picture as usually lagging far behind the clinical response to therapy. The width of the mucosal folds of the jejunum of our latest examination is at the upper limits of normal. The questionable widening may possibly represent the minimal clinical evidence of active disease despite a recent negative biopsy. Even though proof is not available, it may be assumed that the changes of decreased fold thickness are reflected in a similar decrease in cellular infiltration in the intestinal mucosa.

In Case III the barium enema study suggested involvement of the cecum. This has been reported once previously (6), but no confirmation of the suspicion is available.

Some of the other nonintestinal radiological changes found in this disease (3) were not demonstrated in our cases. Generalized lymphadenopathy may lead to a widened duodenal loop and enlarged hilar nodes. Changes, indistinguishable from rheumatoid arthritis especially, have been described in the sacroiliac joints. Due to the long-standing malabsorption, osteomalacia can occur, even though it has not been prominently mentioned. Effusions in serous cavities, such as the ascites in Case III, are frequently observed. We

have found no mention of gross central nervous system, intrapulmonary, hepatic, splenic, or renal involvement.

SUMMARY

1. Three cases of Whipple's disease have been presented, with a discussion of the radiologic findings. Marked small-bowel mucosal thickening is a constant finding, seen most prominently in the proximal small intestine. Flocculation, segmentation, dilatation, and increased transit time may be observed.

2. Particular attention is focused on one case with an eight-year clinical remission and reversion of the roentgenologically abnormal small-bowel appearance to normal.

Department of Radiology
Massachusetts General Hospital
Boston 14, Mass.

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SUMMARIO IN INTERLINGUA

Morbo de Whipple: Constatationes Roentgenologic, Incluse Tales in un Caso de Octenne Remission

Morbo de Whipple es characterisate per diarrhea, malabsorption intestinal, dolores abdominal, lymphadenopathia, e un polyarthritis que pote preceder le altere symptomas per plure annos. In le presente studio, 3 casos de iste morbo es reportate, incluse 1 in que un remission de octo annos in le symptomas clinic esseva accompaniate per un reversion al norma del parte de un grossiermente anormal imagine roentgenologic del intestino tenue. Iste disveloppamento sequeva le administration de steroides e ACTH.

Le plus frappante aspecto roentgenologic in le 3 casos esseva le marcate spissification diffuse del plicas mucosal in le intestino tenue, particularmente in le duodeno e le jejuno superior. Flocculation, segmentation, dilatation, e un augmento del tempore de transito pote esser observate.

The Elevator Esophagus

A Fluoroscopic Clue to Possible Organic Disease[1]

J. R. DREYFUSS, M.D.,[2] and ROBERT G. WILLOCX, M.D.[3]

THIS REPORT IS concerned with a bizarre type of esophageal motility which we feel may be frequently associated with serious organic disease. Seven years ago, during fluoroscopy of an elderly man, an unusual up-and-down motion of the barium was noted in the esophagus, in the upright position. A swallow of barium would remain in the esophagus for several minutes, intermittently rising from the lower esophagus to the level of the aortic arch with moderate speed and then falling back again. Occasionally the barium column would bound rapidly almost to the hypopharynx. This erratic motion resembled that of an elevator gone wild. The patient was very much aware of the abnormal activity and could accurately signal the moment when barium nearly reached the hypopharynx and could also sense when the esophagus had finally emptied into the stomach. This began with squirts of barium, followed by a general relaxation of the lower esophagus and rapid emptying. Careful study by fluoroscopy and esophagoscopy showed esophagitis with multiple small mucosal ulcerations.

During the subsequent six years we have been constantly watching for this type of altered esophageal activity and have seen and recorded 25 examples in the course of 3,365 fluoroscopic examinations of the upper gastrointestinal tract. An additional 4 cases have been brought to our attention by colleagues but will not be included in this report. We shall summarize and present the findings in 20 of the 25 patients who have been examined fluoroscopically by one of us (J. R. D.), on whom we have follow-up studies or a postmortem report.

FLUOROSCOPIC FINDINGS

A to-and-fro motion of barium in the esophagus occurs occasionally in normal persons in the supine or prone position and is frequently seen in elderly or debilitated patients. The pronounced elevator activity which we are describing, however, is a most unusual finding, particularly in the upright or semi-upright position. It is not the projectile ejection seen in vomiting but is rather a pronounced degree of reverse peristalsis in the esophagus, manifesting a variable speed, with an inconstant degree of contraction. None of these patients has actually vomited during fluoroscopy, although some have complained of nausea or of substernal pain, fullness, and pressure.

The initiating wave of contraction begins in the lower esophagus and may be sufficiently strong to propel the bolus of barium immediately to the level of the aortic arch (Fig. 1). If the first contraction is less forceful, it may be followed by one or two more cephalad augmenting contraction waves, or the esophagus may relax temporarily before any significant movement of barium has occurred. The abnormal motility is more likely to be seen following each of the first few swallows of barium and may not recur until the esophagus has been relatively inactive for some time. Subsequent examinations after one hour or even days or weeks have nearly always demonstrated the motor abnormality once it has been detected, provided the underlying pathologic condition is still present.

The elevator phenomenon in the esophagus has not been associated with severe curling (corkscrew esophagus) in any of our cases, although the latter phenome-

[1] Accepted for publication in May 1960.

[2] Instructor in Radiology, Harvard Medical School; Associate Radiologist, Massachusetts General Hospital.
[3] Research Fellow in Medicine, Harvard Medical School; Clinical Fellow in Medicine, Massachusetts General Hospital, Millard Shaler and C.R.B. Graduate Fellow, Belgian American Educational Foundation.

Fig. 1. Fluoroscopic spot-films demonstrating the elevator phenomenon in a patient with esophagitis. A. Barium entering the gastric fundus. B. Contraction wave beginning in the lower esophagus. C. Column of barium which has bounded cephalad to the level of the thoracic inlet. D. The proximal thoracic esophagus filled with barium. E. Some of the barium shown in the previous film is temporarily held in the esophagus above the level of the aortic arch by a more distal contraction.

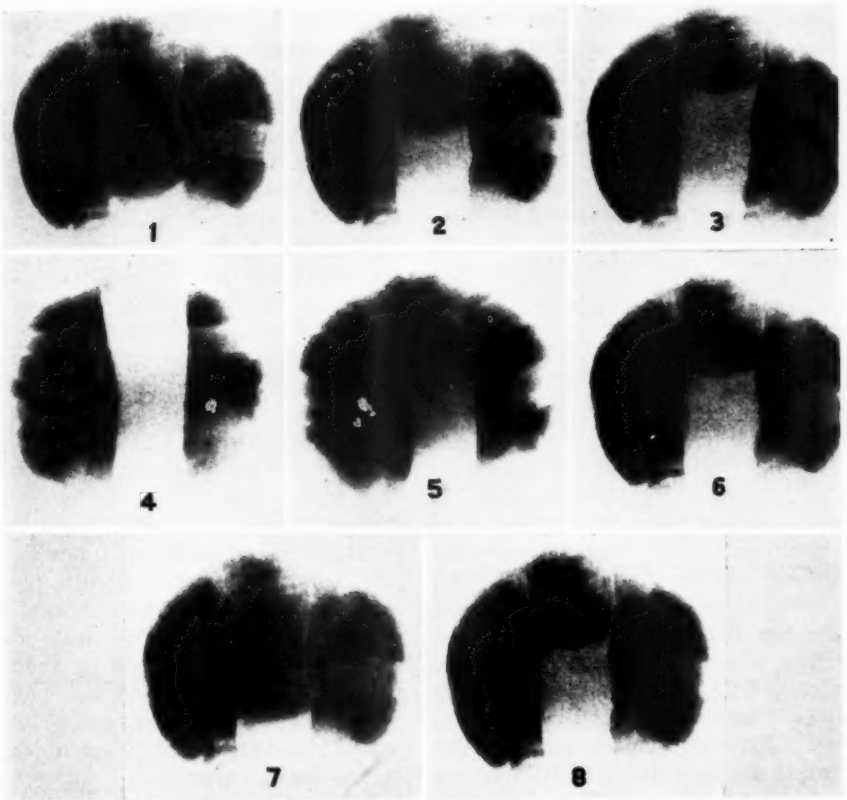

Fig. 2. Eight frames taken at intervals from a motion picture film-strip made at the time of cineradiography. The sequence shows the up-and-down elevator-like motion of a column of barium in the esophagus at the level of the aortic arch.

non may be seen in patients with diffuse esophageal spasm (1). We have not yet encountered this particular type of esophageal activity in a patient with a dilated esophagus or in one with a positive Mecholyl test for cardiospasm (tetanic contraction of the esophagus following the intramuscular injection of 1 to 10 mg. of acetyl-beta-methylcholine) (2). Patients with cardiospasm may show a to-and-fro motion of barium in the esophagus, but the activity is more sluggish and ineffectual than the type we are concerned with in this report.

PATHOLOGICAL AND CLINICAL FINDINGS

The patients ranged in age from twenty-six to seventy-eight years, with a mean age of 55.3 years. Twelve were females and 8 males. Six were studied by esophagoscopy, 10 were explored, and 3 came to autopsy. The pathological findings in the 20 cases were as follows:

Carcinoma of the stomach	3
Multiple myeloma	1
Carcinoma of breast with mediastinal metastases	1
Carcinoma of lung with mediastinal metastases	1
Hodgkin's disease with enlarged nodes in mediastinum and about gastric cardia	1
Abdominal carcinomatosis	1
Carcinoma of colon	1
Esophageal diverticula	3
Hiatus hernia	2
Esophagitis	2
Hiatus hernia and esophagitis	1
Gastritis, bleeding	1
Unexplained transient filling defect in esophagus (? food)	1
Postgastrectomy patient with dumping syndrome	1

We believe it significant that 9 of the 20 patients who exhibited this variant of esophageal motility were found to have malignant tumors in the mediastinum or abdomen. Five of these 9 patients are now dead, 3 are still living with incurable malignant neoplasms, and 1 is alive with no evidence of recurrence three months after extirpative surgery for carcinoma of the colon. One of the patients with known residual malignant tumor had Hodgkin's disease involving nodes in the lower mediastinum and about the gastric cardia. He entered the hospital with dysphagia and evidence of an elevator esophagus and within three days of admission became unable to swallow his own saliva. Following x-ray treatment to the lower mediastinum and gastric cardia he was completely asymptomatic and free from evidence of abnormal esophageal activity. Another patient with dysphagia and a subjective sensation of esophageal dysfunction has become asymptomatic and shows no abnormal esophageal activity at fluoroscopy, following surgical resection of recurrent carcinoma of the stomach and metastatic nodes about the distal esophagus.

The elevator esophagus may signal the presence of a malignant tumor which cannot be demonstrated at the time of gastrointestinal fluoroscopy. One of the patients in this series was a seventy-year-old woman who showed marked elevator activity and lower esophageal spasm (3). During the course of fluoroscopy none of the barium entered the stomach. On the basis of our past experience with this abnormal type of esophageal action we suggested the diagnosis of malignant tumor in or near the gastric cardia. Postmortem examination eighteen days later revealed scirrhous carcinoma of the stomach.

Another patient, brought to our attention by a colleague and not included in this series, was found to have a carcinoma of the cardiac end of the stomach at postmortem examination following a gastric hemorrhage. Six months previously she had been examined because of a burning sensation and pain beneath the sternum, associated with a bitter taste in the mouth. The only abnormal finding reported on that occasion was a to-and-fro motion of barium in the esophagus observed fluoroscopically.

In 11 of the 20 patients there has been no evidence of malignant disease. One is now asymptomatic following resection of two lower esophageal diverticula and no longer shows the elevator phenomenon.

Repair of a hiatus hernia has been similarly effective in another patient. One patient with gastritis, 2 with hiatus hernia, 2 with esophagitis, and 2 with esophageal diverticula are still under medical treatment and all but 2 of them continue to show abnormal esophageal motility. In only 2 patients were we unable to find an underlying organic lesion. One of these had in the lower esophagus a partially obstructing filling defect which disappeared after three days and is presumed to have represented a piece of food. Subsequent esophagoscopy and two fluoroscopic examinations of the esophagus and stomach have been negative. The second patient had a severe dumping syndrome seven years after subtotal gastrectomy for a duodenal ulcer. No explanation was found for the altered esophageal motility in this instance. The patient has become psychotic, with an addiction to narcotics, and is now in a mental hospital.

No constant clinical symptoms could be related to the fluoroscopic findings although a gastrointestinal history was obtained from the hospital record and from those patients whose condition permitted detailed questioning. A summary of these histories follows:[4]

Substernal or epigastric pain	10
Weight loss	10
Food sticking in esophagus	9
Regurgitation	8
Epigastric fullness	8
Heartburn	8
Nausea with or without vomiting	8
Symptoms with fast eating	5
"Elevator sensation" in esophagus	3
Hiccups	2
Food or liquid not tolerated:	
Solids	8
Cold liquids	1
Alcohol and coffee	1

Each of the 20 patients had one or more symptoms referable to the esophagus. In 10 instances there was substernal or epigastric pain and in 10 weight loss ranging from 5 to 80 pounds had occurred. Food sticking in the esophagus was reported by 9 patients, and regurgitation, epigastric fullness, heartburn, and nausea with or without vomiting were each described by 8. Symptoms were more likely to occur if eating was hurried, according to 5 patients. In only 3 cases was there said to be a subjective sensation of a to-and-fro movement of food or liquid in the esophagus.

Of the 7 patients with malignant growth in the mediastinum, esophagus, or stomach, 6 complained of dysphagia and weight loss, and 3 also mentioned such symptoms as substernal pain, regurgitation, nausea, vomiting, and heartburn.

[4] Based on information from 17 patients who could be questioned in detail.

DISCUSSION AND SUMMARY

Twenty cases are presented in 18 of which erratic esophageal motility was a clue to the presence of disease. Nine patients had some form of malignant tumor. We believe that the elevator phenomenon is a reflection of physiological dysfunction of the lower esophagus and we agree with Sweet (4) and Jones (5) that a lesion in or near the lower esophagus may be the trigger mechanism which disturbs normal neuromuscular function. This seems to be borne out by follow-up of the 4 patients who have had surgical or radiation treatment of an obvious lesion in this area. They are now symptom-free and without demonstrable erratic esophageal activity, although in 2 there is known residual malignant disease elsewhere.

The condition we are describing may simulate the clinical picture of cardiospasm, but the fluoroscopic findings are different and our patients have so far shown neither a positive Mecholyl test nor the fixed contraction deformity of cardiospasm (2, 6). There is a similarity to the Barsony-Teschendorff syndrome or segmental esophageal spasm (4), except that the substernal pain is less severe and none of our patients has shown the pronounced segmental contractions or "pearl-necklace" appearance of barium in the esophagus. Diffuse lower esophageal spasm (7, 8) has been associated previously with organic lesions of the esoph-

agus and stomach and it has also been noted in individuals under emotional stress. The elevator phenomenon would seem to be the result of a variant of this type of spasm. Cineradiography has proved an ideal method for recording and studying patterns of esophageal motility and for the past two years we have used it to document the elevator phenomenon (Fig. 2).

We believe that when the abnormal activity of an elevator esophagus is observed on the fluoroscopic screen the radiologist should suspect the possibility of serious organic disease in or near the lower esophagus or stomach. A thorough examination should then be carried out in a search for the underlying cause. In 45 per cent of our cases this was a malignant tumor.

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Massachusetts General Hospital
Boston 14, Mass.

SUMMARIO IN INTERLINGUA

Esophago Ascensor: Un Indicio Fluoroscopic de Possibile Morbo Organic

Le autores describe un bizarre typo de motilitate esophagee que es frequentemente associate con serie morbo organic: un erratic movimento in alto e in basso del barium in le esophago, simile in apparentia a un ascensor amok e observate fluoroscopicamente con le patiente in position erecte. Vinti-cinque casos esseva vidite e registrate in le curso de sex annos in un total de 3.365 examines. In 20 del 25 casos il esseva possibile obtener studios de controlo subsequente o un reporto necroptic. In 9 de iste 20, maligne tumores esseva constatate in le mediastino o le abdomine. Esseva representate 3 casos de diverticulos esophagee, 2 de hernia de hiato, 2 de esophagitis, e 1 cata un de hernia de hiato con esophagitis e de gastritis sanguinante. In solmente 2 casos, nulle subjacente morbo poteva esser discoperite. In 1, le defecto esseva attribuite a un bolo de alimento, e 1 patiente habeva experientiate gastrectomia e suffreva del syndrome de dumping.

Le autores opina que quando le activitate anormal del esophago ascensor es observate in le ecran de fluoroscopia, le radiologo deberea suspicer le possibilitate de serie morbo organic in o proxime al esophago inferior o al stomacho. Un meticulose investigation del subjacente causa debe esser effectuate.

Local Bone-Marrow Changes Secondary to Therapeutic Irradiation[1]

MARGUERITE P. SYKES, M.D., FLORENCE C. H. CHU, M.D., and WILLIAM G. WILKERSON, M.D.[2]

THERE IS little available information in the literature concerning the effect in man of therapeutic roentgen doses to the mediastinum on the cellularity of the sternal bone marrow. Radiosensitivity of the various cellular components of the marrow has been thoroughly investigated (1–4). Irradiation affects the nucleic acids, principally desoxyribosenucleic acid (DNA) (5), with the production of chromosomal damage, associated with mitotic abnormalities (6–10) and perhaps a forced pathological cell maturation (11).

The sequence of events in the bone marrow of animals and man exposed to total-body irradiation has been carefully studied (4, 12–14). After exposures in the range of 300 r there is a gradual depression of the bone marrow with regeneration usually occurring within twelve to sixteen weeks. Denstad (10) believes that after large doses of radiation, the cellularity of the marrow continues depressed. The pattern of recovery from injury follows the same cellular order as is seen initially (4). The most sensitive indication of acute radiation effect is a reduction in number of circulating lymphocytes, together with the appearance of abnormal lymphocytic forms (16, 17). It has been shown that if segments of normal marrow or spleen of mice are shielded during total-body irradiation, this tissue is capable of reseeding the irradiated marrow (18). On the other hand, there is very little information as to whether bone marrow irradiated locally in the therapeutic dose range can be regenerated at all levels of radiation exposure, or whether there is a level at which some permanent marrow injury is induced. The problem of determining the dosage of radiation delivered locally from which the bone marrow can completely recover will be studied.

An initial investigation was performed on autopsy material and a second study was made on living patients. The methods of observation were common to both series. No patient who had received any compound usually considered to be marrow-depressant was included in either group.

I. AUTOPSY SERIES

In the autopsy series, there were 7 patients who had received intensive local irradiation at least two months prior to the time of death. The areas of irradiation and the radiation doses are recorded in Table I. At autopsy, marrow aspirations and bone wedges were taken from five anatomical sites: (*a*) the irradiated area, (*b*) and (*c*) sternum and iliac crest (regardless of exposure); (*d*) unexposed rib, and (*e*) unexposed vertebra.

The bone wedges were fixed in Zenker's solution and, after decalcification by acetic acid, were stained by hematoxylin and eosin for microscopic examination. The slides made from the aspirated marrow material were prepared by the MacNeal tetrachrome method.

A. Method of Evaluation: Following irradiation the marrow was classified as normal, fair, hypocellular, or acellular.

B. Results: The results are presented in Table I. Of 6 subjects who had received an exposure dose at the position of the bone, ranging from 3,700 to 6,500 r in three to seven weeks, six to thirty-six months before

[1] From the Division of Clinical Chemotherapy, Sloan-Kettering Institute for Cancer Research; Departments of Medicine and Radiation Therapy, Memorial and James Ewing Hospitals; Cornell University Medical School, New York. Presented in part at the Ninth International Congress of Radiology, Munich, Germany, July 1959. Accepted for publication in May 1960.

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[2] W. G. W. at present at Margaret Hague Maternity Hospital, Jersey City, N. J.

TABLE 1: AUTOPSY STUDIES OF 7 PATIENTS WHO HAD RECEIVED INTENSIVE LOCAL IRRADIATION AT LEAST TWO MONTHS PRIOR TO DEATH

Diagnosis	Irradiated Area	Energy	Exposure Dose in the Tumor	Exposure Dose at the Bone Position	Time Before Death, Months
Ca. Cervix	Left pelvis	1 Mev 3.4 mm. Pb h.v.l.	4,000 r/3 weeks	4,000 r	36
Ca. lung	Left hemithorax	1 Mev 3.4 mm. Pb h.v.l.	3,400 r/5 weeks	5,400 r	20
Ca. lung	Right hemithorax	1 Mev 3.4 mm. Pb h.v.l.	3,800 r/3 weeks	5,500 r	20
Ca. breast	Right breast	250 kvp 2.0 mm. Cu h.v.l.	3,500 r/3 weeks	3,700 r	12
Ca. kidney	Left humerus	250 kvp 2.0 mm. Cu h.v.l.	6,500 r/7 weeks	6,500 r	6
Ca. breast	Left breast	1 Mev 3.4 mm. Pb h.v.l.	5,700 r/5 weeks	5,600 r	7
Ca. breast	Esophagus	250 kvp 2.0 mm. Cu h.v.l.	3,000 r/4 weeks	1,900 r	2

Table continued on opposite page

death, all but 1 had hypocellular or aplastic marrow.

The 1 patient who received 1,900 r to the rib in a period of four weeks showed fair cellularity at the time of death two months later. The marrow specimens taken from the cavities of nonirradiated bones of these 7 patients showed no sign of secondary hyperplasia, nor was there any evidence of endarteritis obliterans or fibrosis in the irradiated sections.

CLINICAL SERIES

The clinical material included 18 patients with breast cancer who had received routine postoperative irradiation through opposing anterior and posterior fields for the supraclavicular area and a single anterior field for the internal mammary lymph nodes on the side of the mastectomy. The dose to the sternum was considered to be entirely from the internal mammary field. The physical factors were: 250 kevp, 2 mm. Cu h.v.l., and 50 cm. target-skin distance. The size of the internal mammary field was usually 15 × 9 cm. In three and a half weeks, the skin received an exposure dose of 4,000 to 4,500 r.

The determination of the absorbed dose in marrow between interfaces of cortical bone is an extremely complex problem and has been the subject of investigation (19–21). Since no accurate information is available at the present time, the exposure dose[3] instead of the absorbed dose will be quoted in this paper. The exposure dose at the level of the sternal bone marrow has been estimated to be 4,000 to 4,500 r.

Sternal marrow aspirations were done prior to irradiation, after an exposure of 2,000 r, and at the completion of therapy. Thereafter, aspiration was done at intervals of two to three months. At the time of this report, the longest follow-up period was eighteen months. The marrow was obtained with a Turkel needle from the sternum at the level of the second or third interspace. The slides were stained by the MacNeal tetrachrome method. A peripheral blood count was made at each time of marrow aspiration.

In addition to the aspiration biopsies described above, formal sternal bone-marrow biopsies were performed in 6 patients under general anesthesia. The material was then prepared for microscopic examination in the same manner as were the bone wedges obtained at autopsy. A sternal marrow aspiration was taken at the same time as the biopsy, for comparison of technics.

A. Method of Evaluation: From the aspiration material, it was sometimes

[3] The exposure dose calculation is the exposure at the position of the bone and does not consider shielding by the bone or secondary electron enhancement of dose.

TABLE I: AUTOPSY STUDIES OF 7 PATIENTS WHO HAD RECEIVED INTENSIVE LOCAL IRRADIATION AT LEAST TWO MONTHS PRIOR TO DEATH—*cont.*

Diagnosis	Irradiated Sections			Control Sections (Non-Irradiated)		
	Bone	Wedge	Aspirate	Bone	Wedge	Aspirate
Ca. cervix	Iliac crest	Aplastic	No regeneration	Sternum	Slight hypoplasia	Good cellularity
Ca. lung	Rib	Hypocellular	Acellular	Iliac crest	Hypocellular—tumor cells	Fair cellularity
Ca. lung	Rib	Replaced by tumor cells	Hypocellular—tumor cells	Iliac crest	Tumor cells	Tumor cells
Ca. breast	Rib	Acellular	Acellular	Vertebra	Normal marrow	Normal marrow
Ca. kidney	Humerus	Replaced by tumor cells	Hypocellular and tumor cells	Rib	.....	Normal marrow
Ca. breast	Rib	Replaced by tumor	Fair cellularity—tumor cells	Rib	Normal marrow	Cellular marrow—tumor cells
Ca. breast	Rib	Fair cellularity with fat vacuoles	Fair cellularity with fat vacuoles	Vertebra	Normal marrow	Normal marrow

difficult to differentiate between a specimen of peripheral blood and a sample of aplastic marrow. Of help in this respect was the presence, macroscopically, of spicules and fat globules and, microscopically, of osteoclasts, osteoblasts, or megakaryocytes. Another piece of presumptive evidence was the presence of mature plasma cells, which in the adult patient represent less than 1 per cent of the formed elements in the peripheral blood but are more numerous in bone marrow. An example of a cluster of plasma cells from a marrow study is shown in Figure 1.

In the evaluation of the effects of irradiation on the sternum, pretreatment marrows were used as the baseline and subsequent marrows were classified as follows:

Degenerative Phase: The disappearance of marrow cells and their replacement by a fatty gelatinous substance.

Regenerative Phase: (*a*) Very early regeneration: rare myelocytes and normoblasts present.

(*b*) Early regeneration: myelocytes in orderly fashion, pronormoblasts and megakaryocytes; the presence of any two sufficing for inclusion in this category.

(*c*) Incomplete regeneration—normal except for a continuing decreased cellularity.

(*d*) Complete regeneration—normal marrow.

(*e*) Reversal: marrow returning to normal after therapy and then reverting to hypoplasia.

B. Results: The results obtained from the 18 living patients are presented in Figure 3.

After a total exposure of 4,000 to 4,500 r all patients went into the degenerative phase. Eight patients (Cases 9 to 16) failed to show any definite signs of regeneration from nine to eighteen months postirradiation. Eight patients (Cases 1 to 8) showed some signs of regeneration two to eight months after irradiation, but only 1 (Case 3) had a marrow which returned to and remained at approximately the pretreatment level.

Of particular interest in our clinical series were 2 patients whose marrow had returned to normal two months following irradiation but approximately two months later reverted to hypoplasia and remained so at all following aspirations (Cases 17 and 18). This reversal phenomenon is shown in Figure 4.

The results of formal bone biopsies are presented in Figure 3. The marked hypocellularity of a sternal button biopsy taken nine months after irradiation, confirms the marked hypocellularity also seen in the aspirate (Fig. 2). Again, there was no evidence of endarteritis obliterans or fibrosis in any of the specimens obtained and the peripheral blood counts remained normal in all patients.

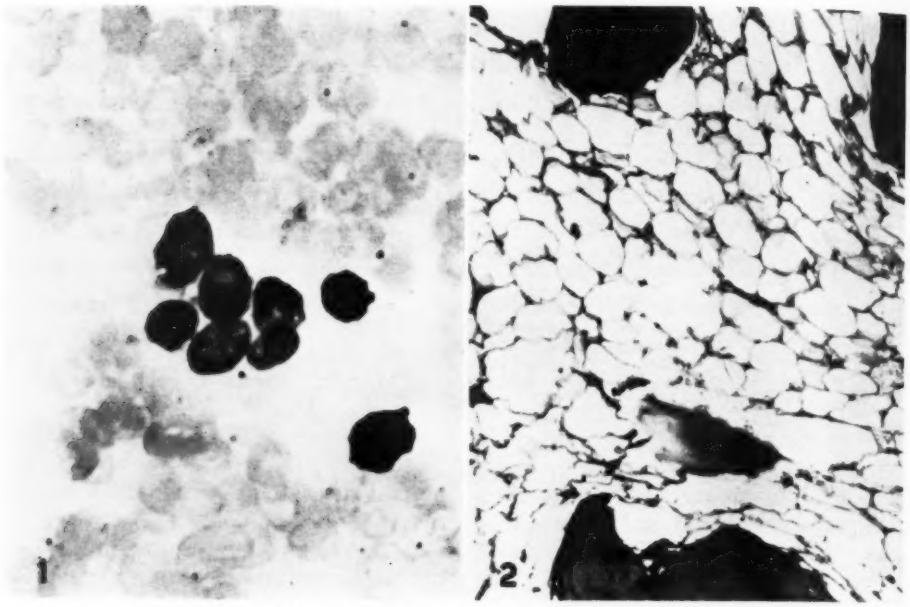

Fig. 1. Example of a cluster of plasma cells in marrow after therapeutic irradiation for breast carcinoma.
Fig. 2. Sternal marrow button biopsy confirming acellularity of marrow.

DISCUSSION

This report comprises the first phase of an attempt to define the morphologic and temporal details of marrow changes following therapeutic doses of irradiation. In the autopsy series of 7 patients, 1 who received 1,900 r in four weeks to the rib showed an essentially normal marrow two months later. Of 6 patients who received higher dosages ranging from 3,400 r in five weeks to 6,500 r in seven weeks, 5 showed severe depression of the irradiated marrow seven to thirty-six months following irradiation.

In the selection of patients for the clinical series an attempt was made to control some of the variables. All the patients were adult males. The treatment schedule was uniform and consisted of an exposure to the area of the sternal marrow of 4,000 to 4,500 r in three and a half weeks. The examination of marrow at regular intervals during and after irradiation permitted an interpretation of the sequence of events.

In this series of 18 patients all had an initial marrow degeneration. Regeneration of a variable degree was apparent in several instances, but in only 1 patient did the marrow return to and remain approximately at the pretreatment level. The inability of the marrow of the remaining 17 patients to regenerate to the pretreatment level could be due to permanent damage to the precursor cells of the marrow elements or to a physiological alteration of the blood vessels and supporting syncytium. These factors could be responsible for the prevention of growth of the regenerating cells and/or the repopulation of cells from marrow in other parts of the body. The sections, however, did not show any evidence of endarteritis obliterans or fibrosis.

The marrow returned to normal in 2 patients two months after irradiation, with subsequent reversion to marked hypoplasia. This reversal phenomenon may possibly be a normal biological procedure in the regenerative process, detected only if marrow aspirations are performed at frequent intervals. The in-

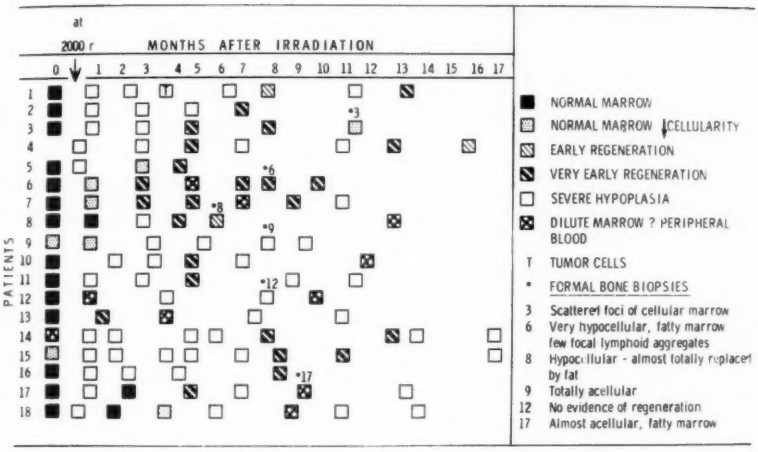
at
2000 r
MONTHS AFTER IRRADIATION
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
PATIENTS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
NORMAL MARROW
NORMAL MARROW ↓CELLULARITY
EARLY REGENERATION
VERY EARLY REGENERATION
SEVERE HYPOPLASIA
DILUTE MARROW ? PERIPHERAL BLOOD
T TUMOR CELLS
• FORMAL BONE BIOPSIES
3 Scattered foci of cellular marrow
6 Very hypocellular, fatty marrow few focal lymphoid aggregates
8 Hypocellular - almost totally replaced by fat
9 Totally acellular
12 No evidence of regeneration
17 Almost acellular, fatty marrow

Fig. 3. Results of marrow aspiration (clinical series).

cidence, duration, and time of appearance of such an abortive regeneration may depend on the radiation dose and its fractionation and protraction. Only by further study can this be determined.

It is interesting to note that the changes in the mitotic index of marrow following total-body irradiation in the Y^{12} accident at Oak Ridge Institute of Nuclear Studies showed a similar pattern (22). All in the heavy exposure group (236–365 rads) showed a depression in the mitotic index on the fourth day, with a rise on the eighth day and a secondary fall by the sixteenth day. Thereafter, the counts were significantly above normal. In the 3 men who received 20 to 60 rads, the depression at four days was slight. The counts were within normal limits at all later studies. Thus, the pattern of recovery appeared to depend on the dose received.

The comparison of the aspiration biopsies with the bone buttons established the value of the comparatively simple marrow-aspiration technic as a true reflection of the status of the marrow. The sternal aspiration appeared to err occasionally in producing a more cellular specimen than that obtained in the bone sections.

That the peripheral blood counts were within normal limits at the time of marrow hypoplasia is not unexpected when it is

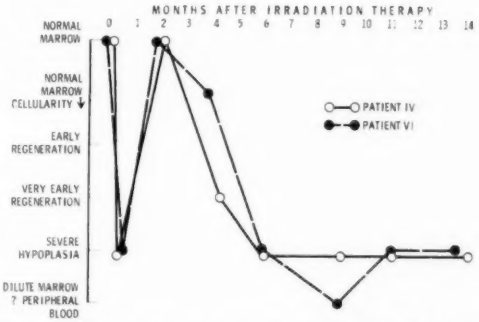
MONTHS AFTER IRRADIATION THERAPY
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
NORMAL MARROW
NORMAL MARROW CELLULARITY ↓
EARLY REGENERATION
VERY EARLY REGENERATION
SEVERE HYPOPLASIA
DILUTE MARROW ? PERIPHERAL BLOOD
PATIENT IV
PATIENT VI

Fig. 4. Illustration of reversal phenomenon (clinical series).

realized that the amount of marrow receiving irradiation was less then 3 per cent of the total active adult marrow (23). The question is raised as to whether the return of the therapeutically irradiated marrow to pretreatment levels is the exception rather than the rule. Further studies are contemplated to define the morphologic and functional capacity of marrow at varied doses of localized radiation as well as to determine the critical dose required to damage the bone marrow permanently.

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444 East 68th St.
New York 21, N. Y.

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(Pro le summario in interlingua, vider le pagina 931)

The Significance of Grid Ratio in Clinical Radiography[1]

BENJAMIN FELSON, M.D.,[2] and OTTO E. W. SCHMIDT[3]

ALMOST from the time Roentgen discovered x-rays it has been known that secondary radiation reaching a radiographic film causes an overall photographic fog which reduces contrast and sharpness, detracting greatly from the perceptibility of anatomic details (1). With the invention and improvement of x-ray grids by Bucky, Potter, and others, a practical means of trapping a significant proportion of the "scatter" was provided, resulting in tremendous enhancement of the quality and diagnostic possibilities of the finished roentgenogram (2, 3). Later experience established that the quantity of the secondary radiation reaching the film varied with the thickness and composition of the part being radiographed and with the kilovoltage employed (4, 5). But the fact that the proportion of secondary radiation absorbed by a movable or stationary grid is dependent on the type of grid was overlooked for many years by most radiologists.

One of the primary factors responsible for grid effectiveness is grid ratio, and it is with this factor that we are concerned here. The effect of different grid ratios on the quantity of secondary radiation reaching the film has been investigated in the laboratory with phantoms (2, 3, 5). We know of no investigation of grid ratios, however, based on an entirely clinical approach. The present report describes an attempt to evaluate grids of different ratio with respect to their relative ability to produce good diagnostic radiographs and to correlate clinical and laboratory results.

The term *grid ratio* is defined as the ratio of the height of the lead strips to the distance between them (6). *Thickness of the lead strip* refers to that dimension of the lead which is at right angles to the primary radiation reaching the grid (Fig. 1).

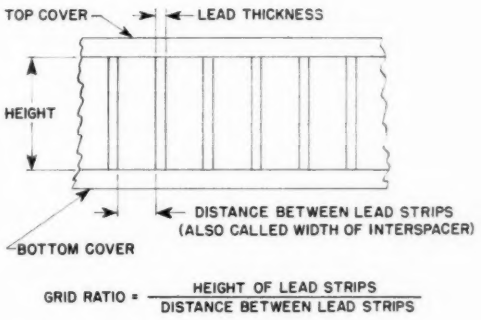
TOP COVER
LEAD THICKNESS
HEIGHT
DISTANCE BETWEEN LEAD STRIPS
(ALSO CALLED WIDTH OF INTERSPACER)
BOTTOM COVER
GRID RATIO = HEIGHT OF LEAD STRIPS / DISTANCE BETWEEN LEAD STRIPS

Figure 1

There are several qualities which determine the effectiveness of a grid. The most important of these is the "clean-up"—the amount of secondary radiation removed—which should be high for maximum effectiveness. Of scarcely less importance is the amount of absorption of the primary beam, which should be low to insure a short exposure time and minimum irradiation of the patient. Primary absorption becomes more important as clean-up is increased. Because efficient clean-up removes a large quantity of radiation, primary absorption should be as low as possible to obviate the necessity of unduly increasing the exposure to obtain adequate film blackening.

The clean-up quality of a grid is determined chiefly by its ratio and by the thickness of its lead strips. It is affected to a considerably lesser degree by the thickness and density of the covering material. Other things being equal, the higher the grid ratio and/or the thicker the lead strips, the better the clean-up. If the covers are made of a dense material

[1] From the Department of Radiology, University of Cincinnati College of Medicine, and Cincinnati General Hospital, Cincinnati, Ohio. Aided by a grant from Liebel-Flarsheim Company. Accepted for publication in February 1960.

[2] Professor of Radiology, University of Cincinnati College of Medicine; Director, Department of Radiology Cincinnati General Hospital.

[3] Research Engineer, Liebel-Flarsheim Company.

of a significant thickness, they will also absorb some of the secondary radiations, especially those which emanate at shallow angles to the film surface. That is, secondary radiation which forms a large angle with the primary radiation will have a comparatively longer path through the covers of the grid and thus be attenuated. This desirable effect is more than offset, however, by the increased primary absorption of the covers.

Absorption of the primary beam is influenced by the thickness of the lead strips, the number of strips per inch, the density and height of the interspace material, and the density and thickness of the covers. As the value of any of these factors increases, the primary absorption is increased. For example, if the number of lead strips per inch is held constant but their thickness is increased, the lead will constitute a larger part of the total surface area, leaving a smaller "window" for radiation to pass through. Similarly, light metal interspacers will absorb more radiation than organic material, such as paper.

METHOD OF INVESTIGATION

In the present investigation all factors of grid construction were held constant except the ratio. The thickness of the lead strips and number of lines per inch were identical. The low-density fiber-paper interspacers and the thin aluminum covers were the same in all grids. Varying the grid ratio necessitated change in interspacer height, which changed the height of the grid, altering the primary absorption. Since, however, the density of the paper is very low, this effect was considered to be negligible for our purposes.

Six stationary aligned grids were constructed with the following ratios: 5:1, 8:1, 12:1, 16:1, 5:1 and 8:1 criss-cross. All had 80 lines per inch and lead strips of 0.002 inch thickness. Each had, at top and bottom, an aluminum cover 0.012 inch thick. It should be noted that a criss-cross grid consists of two identical grids oriented at right angles, one on top of the other. The stated ratio of a criss-cross grid is that of either of its two components. A special tunnel was constructed into which each grid and cassette could be placed in turn. Thus, successive exposures could be made of a single body part without movement of the subject or change in the orientation of the grids and films relative to the roentgen beam.

Because of the large number of exposures required, cadavers were used throughout the study, thus obviating problems of patient movement and avoiding overexposure of living subjects. Roentgenograms of each body part selected for study were made at three different kilovoltages: low, medium, and high. The low kilovoltage range was determined from the formula $2T + 28$ *kvp*, where T represented the thickness of the part in centimeters. The medium kilovoltage range was, in most instances, 25 kvp higher than this, and the high range was 123 kvp. Radiographs of every body part selected were obtained with each of the six grids at all three kilovoltage levels. In addition, a non-grid exposure of each part at each kilovoltage was made for comparison. A target-film distance of 40 inches was used throughout. All exposures were made on high-speed film, with medium-speed intensifying screens.[4] The same cassette and pair of screens were used for all exposures, and all the films of a body part at each kilovoltage were developed simultaneously. After each exposure the cassette was emptied and reloaded.

Since each grid required different exposure factors, a problem of differences of photographic density from one film to another was created. Films with significantly different densities obviously could not be compared. To eliminate this variable so far as possible, the first part of the project was devoted to balancing the exposure factors for all grids at each voltage so that all the resultant films would have the same average visual density. This problem was a difficult one, since "average film density" is largely a sub-

[4] Ilford Red Seal Film and Par-speed Screens.

TABLE I: RELATIVE EXPOSURES USED TO PRODUCE COMPARABLE RESULTS

Grid Ratio	50–75 kvp	75–100 kvp	100–125 kvp
No grid	1	1	1
5:1	3	3	3
8:1	3.7	4	4.2
12:1	4.7	5.5	6.2
16:1	5.7	6.7	8
5:1 criss-cross	5.7	5.5	6.2
8:1 criss-cross	6.7	7.5	9

TABLE II: EXPOSURES USED TO OBTAIN COMPARABLE RESULTS

Grid	2T + 28 kvp 50 ma (sec.)	2T + 53 kvp 50 ma (sec.)	123 kvp 25 ma (sec.)
Anteroposterior Pelvis and Anteroposterior Skull Projections			
No grid	3/10	1/10	1/30
5:1	8/10	3/10	1/10
8:1	1	4/10	1/10
12:1	1 1/4	11/20	2/10
16:1	1 1/2	7/10	1/4
5:1 criss-cross	1 1/2	11/20	2/10
8:1 criss-cross	1 3/4	8/10	7/20
Anteroposterior Chest Projections			
	2T + 28 kvp 50 ma (sec.)	2T + 53 kvp 25 ma (sec.)	123 kvp 25 ma (sec.)
Grid			
No grid	1/10	1/10	1/30
5:1	2/10	1/4	1/10
8:1	4/10	3/10	1/10
12:1	5/10	4/10	2/10
16:1	6/10	5/10	1/4
5:1 criss-cross	5/10	4/10	2/10
8:1 criss-cross	7/10	6/10	7/20
Anteroposterior Knee Projections			
	2T + 28 kvp 50 ma (sec.)	2T + 73 kvp 25 ma (sec.)	123 kvp 25 ma (sec.)
Grid			
No grid	1/10	1/30	1/60
5:1	4/10	1/20	1/30
8:1	5/10	1/20	1/30
12:1	6/10	1/10	1/20
16:1	8/10	3/20	1/20
5:1 criss-cross	8/10	1/10	1/20
8:1 criss-cross	9/10	3/20	1/10

jective quality. It was further complicated by the contrast differences caused by the different grid ratios. As the contrast increased, the "whites" became whiter and the "blacks" needed to be made blacker to maintain the same average density. Agreement as to what constituted average density was difficult to achieve. At first an attempt was made to attain uniformity through the use of densitometry. When this proved inadequate the films were subjectively compared, side by side, on viewboxes of matching intensity and color. Through trial and error the exposure factors were adjusted so that films with reasonably consistent average density for each body part at each kilovoltage were obtained with the different grids.

All exposures for each kilovoltage were made with the same milliamperage, so that only the exposure time was varied. This was done to avoid density variations from possible inaccuracies in current calibration of the x-ray generator at different settings. For example, the calibration of the generator might be such that the tube current on the 25 ma setting was slightly low, while the tube current on the 50 ma setting was slightly high. In this case, a one-second exposure at 25 ma would not be equal to a one-half-second exposure at 50 ma, even if the timer were perfectly accurate. By using the same current setting for all exposures at a given kilovoltage this was obviated. Random variations in kilovoltage and tube current due to momentary changes in line voltage were unavoidable. It was appreciated that varying the time through a wide range might introduce its own inaccuracies, due to the reciprocity law failure characteristic of the film-screen combination used (7), but such variations were felt to be negligible.

Table I shows the relative exposures, with the non-grid exposure taken as unity, which were found by this means to produce films closely enough matched to eliminate substantially the variable of photographic density. Table II shows the actual exposure settings used to produce the radiographs which were compared in this study.

With the exposure factors in Table II, a complete series of comparable radiographs were made on the pelvis, skull, chest, and knee of cadavers. In order to obtain maximum grid effect no coning was used. Due to mechanical difficulties at the time, the 16:1 ratio grid had to be omitted for the skull films. With this exception there were available for study 21 exposures of each part, or 81 films in all. Each group included six films of an

TABLE III: AVERAGE SEQUENTIAL RATINGS

Grid Ratio	*Pelvis* 69 kvp	94 kvp	123 kvp
5:1	6	6	6
8:1	2	5	5
12:1	3	2	3
16:1	5	4	2
5:1 criss-cross	1	3	4
8:1 criss-cross	4	1	1
Grid Ratio	***Skull*** **62 kvp**	**87 kvp**	**123 kvp**
5:1	5	5	5
8:1	4	4	4
12:1	3	1	2
16:1	..	..	..
5:1 criss-cross	2	3	3
8:1 criss-cross	1	2	1
Grid Ratio	***Chest*** **76 kvp**	**96 kvp**	**123 kvp**
5:1	6	6	5
8:1	5	5	4
12:1	3	3	2
16:1	1	1	2
5:1 criss-cross	4	4	3
8:1 criss-cross	2	2	1
Grid Ratio	***Knee*** **54 kvp**	**97 kvp**	**123 kvp**
5:1	2	6	5
8:1	1	5	2
12:1	6	3	3
16:1	3	2	1
5:1 criss-cross	5	4	4
8:1 criss-cross	4	1	5

identical anatomic part, evenly matched in average density, exposed at the same voltage and amperage, with all variables controlled except the grid ratio.

The complete set of test radiographs was graded by one of the authors (B. F.) and then submitted to eleven other radiologists, all with a known interest in this field. Four different cities were represented by this group. All identification on the film was masked and the films in each group were arranged in random order. Two different methods of grading were used. One was a sequential system, in which the best film in the group was rated *1*, the next best, *2*, and so on through *6*. The other was a point system, in which a theoretically ideal film was assigned 10 points and the films were graded downward as they departed from this ideal. Nearly all of the participating radiologists graded by both methods.

The grading was entirely subjective, the only instruction to the radiologist being that he evaluate the film quality from the standpoint of his preference for overall practical diagnostic usefulness. No attempt was made to select for him the criteria on which to base these judgments. Since the sequential system of grading sometimes forced the viewer to make a specific choice between films of practically identical quality, this system must be considered more arbitrary and less sensitive than the point system, in which several films might receive the same grade.

TABLE IV: AVERAGE 10-POINT RATINGS

Grid Ratio	*Pelvis* 69 kvp	94 kvp	123 kvp
5:1	5.9	6.3	5.1
8:1	9.0	7.5	5.6
12:1	8.4	8.8	7.1
16:1	7.7	8.0	8.1
5:1 criss-cross	9.5	8.1	6.6
8:1 criss-cross	7.4	9.3	8.4
Grid Ratio	***Skull*** **62 kvp**	**87 kvp**	**123 kvp**
5:1	6.9	5.9	6.8
8:1	7.4	6.6	7.0
12:1	8.3	7.8	7.9
16:1	..	..	..
5:1 criss-cross	8.6	7.1	7.6
8:1 criss-cross	9.1	7.6	8.0
Grid Ratio	***Chest*** **76 kvp**	**96 kvp**	**123 kvp**
5:1	6.1	5.4	4.8
8:1	7.0	5.9	5.0
12:1	9.0	7.6	8.0
16:1	9.1	8.8	8.1
5:1 criss-cross	7.5	6.9	7.0
8:1 criss-cross	8.4	8.9	9.1
Grid Ratio	***Knee*** **54 kvp**	**97 kvp**	**123 kvp**
5:1	8.4	7.6	7.0
8:1	8.7	7.4	8.1
12:1	8.0	7.6	7.9
16:1	8.1	7.7	8.1
5:1 criss-cross	7.7	8.0	6.9
8:1 criss-cross	8.0	7.6	6.3

RESULTS

All the sequential grades for a given grid with a given part at a given kilovoltage were averaged. These averages were then reassigned sequential values, which are recorded in Table III. Point system values were averaged in the same way, and the averages listed in Table IV.

Prior to this study we had assumed that the diagnostic quality of films would improve in direct proportion to the grid ratio.

TABLE V: SUGGESTED CRITERIA FOR GRID RATIO SELECTION

Grid Ratio	Relative Clean-up	Positioning Latitude*	Preferred Kilovoltage	Relative Exposure†	Remarks
5:1 Linear	Low	Wide	Below 80	Very low	Good for portable and operating room use because of position latitude
8:1 Linear	Medium	Centering—restricted Leveling—restricted Distance—moderate	Below 90	Low	Satisfactory clean-up under 90 kvp
12:1 Linear	High	Restricted	Below 110	Medium	Good compromise for use at both low and high kvp
16:1 Linear	Very high	Almost none	Above 100	High	Good at high kvp
5:1 Criss-cross	High	Wide	Below 100	High	Clean-up equivalent to that available with high-ratio grids, but better positioning latitude. Tube cannot be angled
8:1 Criss-cross	Very high	Centering—restricted Leveling—restricted Distance—moderate	Up to 125	Very high	

* There are three common problems in positioning of a grid: (1) centering it relative to the central ray; (2) leveling it perpendicular to the central ray; (3) placing it at an appropriate distance from the tube target. *Allowable* variation in these is represented in this column.

† This column refers to the relative milliampere-seconds required to obtain similar average film density, with the same kilovoltage.

The effect of criss-cross grids was more difficult to predict because of their two-directional clean-up but the low grid ratio of their individual components. Laboratory tests had shown that at 100 kvp the 5:1 ratio criss-cross grid was approximately equivalent in clean-up to the 12:1 ratio linear grid; that below 100 kvp it was somewhat better, and that above 100 kvp it was not as good. Similar tests indicated that the 8:1 ratio criss-cross grid was equivalent to the 16:1 ratio linear grid at 125 kvp but considerably better at lower voltages.

Statistical analyses[5] were made of the ratings assigned by the various radiologists. Briefly, these analyses indicated very good agreement among the radiologists and a high reliability for the assigned ratings. In particular, the correlation between grid ratio and diagnostic quality was found to be statistically significant. Tables III and IV, while not absolutely consistent with each other, were in very good agreement. The major inconsistency is to be found in the ratings on the knee, which clearly demonstrate the arbitrary nature of the sequential grading system in contrast to the point system. Presumably, because this thin anatomic part produces relatively little secondary radiation, there is not much scatter for the grid to clean up and the similarity of the films affords little choice among them.

Both tables indicate that, except for the knee, the 5:1 ratio linear grid rated poorest and, in every instance except the low kilovoltage pelvis exposures, the 8:1 ratio linear grid rated next poorest. In most cases the 5:1 criss-cross grid was rated next. The 12:1 linear, 16:1 linear, and 8:1 criss-cross grids were best of all, and were given nearly the same ratings, with a slight edge in favor of the 8:1 criss-cross.

COMMENT

Most of the participating radiologists preferred the lower kilovoltage radiographs for the pelvis, skull, and knee. Generally speaking, the preference was for lower kilovoltages for bone detail and medium kilovoltages for soft-tissue visualization. Opinion was divided regarding the choice of high- or low-kilovolt technics for the chest. Except for this area, there was general agreement that too much information was lost as the kilovoltage approached 125 kvp. This was true even with the higher ratio grids, and was probably due less to a lack of clean-up than to the in-

[5] This analysis, compiled by Dr. Theodor D. Sterling, Director of the Biometrics Section of the Department of Preventive Medicine, University of Cincinnati College of Medicine, is available, upon request from the authors.

herent decrease in contrast which occurs at higher kilovoltages.

In spite of considerable effort to establish exposure factors which would produce uniform films in each series, the densities obtained were not perfectly matched. This probably had some effect on the ratings. At the higher kilovoltages, most of the viewers felt that films made with the 5:1 ratio grid were not diagnostically acceptable. One viewer preferred the non-grid to the grid films in the low-kilovoltage series of knee radiographs, but in all the other regions grid films were preferred by everyone.

Table V lists some criteria for grid-ratio selection based on the present study as well as on past experience (8). It is offered as an aid to the optimum utilization of x-ray grids in everyday practice.

Despite a few discrepancies, it is believed that the findings in the present study are a dependable indication of the results the practicing radiologist can expect from the use of grids of different ratios at various kilovoltages. While only stationary grids were used in this study, the results should apply equally to grids moved by the mechanism of a Potter-Bucky diaphragm.

SUMMARY AND CONCLUSIONS

This paper reports a study of the importance of grid ratio in the production of diagnostic radiographs. Stationary grids of different ratios were utilized in x-ray studies of various anatomic parts of cadavers at low, medium, and high kilovoltages. Efforts were made to eliminate all variables other than the grid ratio. The resulting roentgenograms were then compared for relative diagnostic quality by twelve radiologists. Their ratings yielded the following conclusions:

1. For thicker body parts, where grid effect is most needed, the 8:1 criss-cross grid usually produces the best diagnostic quality, followed closely by the 16:1 linear and 12:1 linear, in that order. The 12:1 linear and 5:1 criss-cross grids are approximately equivalent at low and medium kilovoltages, but the 12:1 is much better at high kilovoltage. The 8:1 ratio linear grid, in general, rates considerably below the 12:1, and the 5:1 linear grid rates considerably below that.

2. The improvement in radiographic quality resulting from increasing the grid ratio is most striking at high kilovoltage. Films made at high kilovoltage with the 5:1 ratio linear grid are often poor in quality.

3. For regions which produce relatively little secondary radiation, such as the extremities, there is little to choose from among the various grid ratios.

4. In general, the results achieved in this study tend to bear out those previously found in laboratory investigations.

While not a basic part of this study, an interesting observation which emerged from it was that most of the viewers preferred the low- and medium-kilovoltage radiographs for all regions except the chest. Even in chest radiography there was no unanimity of opinion regarding the value of high-kilovoltage technics.

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Cincinnati General Hospital
Cincinnati 29, Ohio

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SUMMARIO IN INTERLINGUA

Le Signification del Calibre de Grillia in le Radiographia Clinic

Esseva studiate le importantia del calibre de grillia in le production de roentgenogrammas diagnostic. Grillias stationari de varie calibres (5:1, 8:1, 12:1, 16:1, 5:1 intercruciate, e 8:1 intercruciate) esseva usate in studios roentgenologic de varie partes anatomic de cadaveres a basse, medie, e alte kilovoltages. Le radiogrammas esseva comparate in lor qualitate diagnostic per dece-duo radiologos. Le analyse de lor evalutation demonstra que:

(1) Pro le spisse partes del corpore, in que le effecto del grillia es le plus necessari, le grillia 8:1 intercruciate produce usualmente le optime qualitate diagnostic, sequite—proximemente—per 16:1 linear e alora 12:1 linear. Le grillias 12:1 linear e 5:1 intercruciate es approximativemente equivalente a basse e medie kilovoltages, sed a alte kilovoltages le grillia 12:1 es multo melior. Le grillia 8:1 linear, a generalmente parlar, es multo inferior al grillia 12:1, e le grillia 5:1 linear es multo inferior al 8:1.

(2) Le melioration del qualitate radiographic que resulta ab un augmento del proportion del calibre de grillia es le plus frappante a alte kilovoltages. Pelliculas facite a alte kilovoltages con le grillia 5:1 linear es frequentemente inferior.

(3) In le caso de regiones del corpore in que il occurre pauc radiation secundari, per exemplo le extremitates, le differentias inter le varie calibres de grillia es pauco significative.

(4) A generalmente parlar, le resultatos del presente studio tende a corroborar illos de previe investigationes laboratorial.

SUMMARIO IN INTERLINGUA

Local Alterationes de Medulla Ossee, Secundari a Irradiation Therapeutic

(*Pagina 919*)

Iste reporto comprende le prime phase de un essayo de definir le detalios del alterationes de medulla ossee que occurre post irradiation local intra le limites del dosages therapeutic. Le material include un serie de necropsias, consistente de 7 patientes qui habeva recipite intense irradiation local al minus duo menses ante le morte, e un serie clinic de 18 patientes de cancere mammari qui habeva recipite routinari irradiation post-operatori. In le serie de necropsias, un patiente, qui habeva recipite 1.900 r in quatro septimanas dirigite al costa, monstrava duo menses plus tarde un medulla essentialmente normal. Inter le 6 alteres, qui habeva recipite plus alte doses (i.e. inter 3.400 r in cinque septimanas e 6.500 r in septe septimanas), 5 exhibiva un depression sever del irradiate medulla septe a trenta-sex menses post le tractamento.

In le serie clinic de 18 casos con exposition del area del medulla sternal a inter 4.000 e 4.500 r in tres septimanas e medie, omnes manifestava initialmente un degeneration del medulla. Regeneration a varie grados esseva apparente in plure casos, sed il poteva esser constatate in solmente 1 patiente que le medulla retornava a approximativemente le nivello pretractamental e permaneva a illo. In 2 patientes le medulla retornava al nivello normal duo menses post le irradiation, con reversion subsequente a hypoplasia.

Growth and Development

VIII. Relation of Osseous Development in Newborn Negro Infants to Sex, Weight, Length, Skin Color, and Reflex Maturity Index in the Infant and to Such Maternal Factors as Parity, Length of Gestation Period, Prenatal Nutrition, Age, Height, and Socio-Economic Status.[1]

GADSON J. TARLETON, JR., M.D., E. PERRY CRUMP, M.D., and CARRELL P. HORTON, M.A.

THE PRESENCE or absence of certain centers of ossification at birth has proved a valuable criterion in the determination of newborn maturity. Birth weight, various body dimensions, and several performance achievements, among other criteria, have also been employed to measure the degree of development in the neonate. The range of correlation between these factors, as expected, is wide.

Some studies imply racial differences in ossification characteristics, while others reveal specific racial and sexual patterns in the roentgen appearance of these centers. Dunham, Jenss, and Christie (1) found the center for the cuboid to be present more frequently in Negro than in white newborn infants of the same birth weight. For a given race, the center was present more often in the female. Later, in an expanded study by Christie and his associates (2), the presence of the cuboid center at birth showed marked, constant correlation with birth weight and crown-heel length, among both Negroes and whites, correlation with gestational age (except in white girls of forty-two weeks or more gestational age), correlation with the age of the mother (especially older mothers), and no racially consistent correlation with parity.

Hess and Weinstock (3), following an investigation of the incidence of carpal centers in white and Negro newborn infants, stated that the carpal centers are more often present in the Negro than in the white, and in females than in males. Large infants of their series were more apt to show early development of centers than small ones. Quoting Friedenthal's statement that the extremities of Negroes are longer than those of Europeans, they conjectured that this is the probable explanation for the developmental differences.

Kessler and Scott (4), in a study of the right knee of Negro infants, found that whenever the proximal tibial epiphyseal center is present, a center for the distal femur also exists, and that usually the femoral center is larger. Again, the centers were more often seen in girls. They were also larger for girls, especially for small babies. These authors were unable to show correlation of the birth weight, body length, or size of the center to economic status or to milk intake.

Kelly and Reynolds (5) studied 305 white and 120 Negro newborn infants of low socio-economic level. They found the order of appearance of carpal centers to be capitate, hamate, triangular, and lunate in both sexes of the white and Negro groups. The center was generally largest in Negro females, with Negro males, white females, and white males following in order. The same was true of the total carpal area.

Christie (6) studied the newborn infants of mothers admitted to the ward service with complicated pregnancy or as poor obstetric risks, and excluded from consideration multiple births and syphilitic infants. He found the order of "presence frequency"[2] of the ten centers studied to be: first, the os calcis, then the talus, distal femur, proximal tibia, cuboid, head of the humerus, capitate, hamate, third cuneiform, and the humeral head. There was

[1] From the Departments of Radiology and Pediatrics, George W. Hubbard Hospital and Meharry Medical College, Nashville, Tenn. Accepted for publication in May 1960.

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[2] "Presence frequency," as used in this paper, refers to the incidence of appearance of ossification in a center for a single age group (*e.g.*, neonates), as seen on a roentgenogram.

no significant asymmetry in development of the centers. Noting the racial and sexual differences in weight-osseous development at birth, Christie expressed the opinion that the concept of prematurity may need to be revised.

Anderson *et al.* (7), from a study of 3,389 white and 2,297 Negro newborn infants, concluded that race as well as sex should be considered in the definition of prematurity. The above-mentioned reports reveal that certain ossification centers are more frequently visualized roentgenographically in Negro than in white infants.

Many other studies have been conducted but without reference to racial differences. Adair and Scammon (1921) studied ossification at the knee, wrist, and ankle in 45 female and 55 male infants within forty-eight hours after birth (8), at the Swedish Hospital of Minneapolis. The mothers were "of the better class and of considerable intelligence." In this group there was correlation of the center for the upper tibia and cuboid with both length and weight, the correlation being greater with length of the infant. With gestational ages from two hundred and seventy to three hundred days, close correlation was found between the inferior femoral center and weight, and for weight and length. Ossification was more advanced for females, despite their smaller length and weight. There was no relationship between parity and ossification rate. The order of appearance of the centers was: inferior femoral, upper tibial, cuboid, capitate, and hamate. Since the inclusion of Negroes was not mentioned, it is fair to assume that the data in this study refer only to white subjects.

Menees and Holly (9) studied 640 newborn (within forty-eight hours after birth) infants, only 2 of whom were Negroes. Stuart (10), in 1934, published ossification data on the hands and feet of children from birth to twenty-four months of age. Vogt and Vickers (11) continued Stuart's study and, in 1938, published drawings showing normal variations of osseous growth and development. These drawings were constructed from the hands and feet of 112 female and 116 male infants. Roentgenograms were usually obtained within forty-eight hours of birth, but in some instances up to two weeks after birth. The 10 per cent of cases showing the least and the 10 per cent exhibiting the most advanced development were omitted. This study was made only on infants whose mothers had been followed in the prenatal clinic, however, and included only native-born whites whose ancestors, with very few exceptions, were born in the United States, Canada, or Northern Europe. No attempt was made to correlate the findings with weight, length, or other developmental criteria. Yet the drawings of Vogt and Vickers are used widely as a standard of bone development and growth from birth to six and a half years of age.

Sontag *et al.* (12) counted the number of centers present in the left upper and lower extremities from birth to five years of age in 149 children of the Fels Research Institute studies and constructed sigmoid curves showing the time of appearance of the centers according to sex. They found girls to have more centers during this period than boys. The greatest acceleration in ossification for girls was between twelve and forty-two months, and for boys between eighteen and forty-eight months. Three of their infants were Negroes (1 boy and 2 girls). Reynolds and Asakawa (13) counted the number of centers present in the hand and wrist and in the foot and ankle of 58 male and 61 female white infants also from the Fels Research Institute and derived a classification of the rate of development by sex (girls faster than boys). They determined for each center the average of appearance and the age when, in the absence of that center, the development of an infant may be considered as "slow" or "very slow." They concluded that between 60 and 70 per cent of the ratings made on either hand or foot will give the same classification of skeletal status as would be obtained if films of the whole body were available. This study makes no mention of racial distribution.

Perusal of the commonly used atlases of

bone development reveals that data concerning Negroes are largely excluded from the material forming the basis for these accepted standards. The suggestion has even been made that the standards of development be applied without racial qualification.

Completing a study initiated by T. Wingate Todd, Greulich and Pyle (14) published in 1950 a detailed atlas of osseous development. Their report included material collected by Professor Todd through 1936. One thousand children between three months and fourteen years of age were studied. All were white and born in the United States, and nearly all were of North European ancestry.

Todd (15), with his associates, had examined roentgenograms of 4,000 children from three months to sixteen years of age. Their exploratory series covered groups of various socio-economic and nutritional levels. The subjects were predominantly white and included an unlisted number of Negroes. Standards (for the hands) were chosen to represent successive ages of maturity, to be applied to children from "all grades of society." But the standards themselves were selected from groups of children of white stock, ultimately of European origin. Todd stated that these were to be applied also to children of Negro parentage, inasmuch as "there is no practical distinction in determinators or in age relationships to differentiate white from colored of similar social standing." However, the reported racial differences in time of appearance of ossification centers in newborn infants suggest the possibility of similar ossification differences between Negro and white infants and children aged three or more months.

Camp and Cilley (16), in 1931, published a chart depicting the time of appearance and union of ossification centers. No reference to source and type of material was mentioned except that many of the drawings were copied, with certain modifications, from standard anatomical texts and other sources. The publication came in response to frequent requests for copies of the chart devised by the authors and used in the Roentgenology Section of the Mayo Clinic. This chart was revised by Girdany and Golden in 1952 (24) in light of information accumulated during the preceding twenty years. This new information was taken chiefly from the work of Vogt and Vickers, Scammon, Milman and Bakwin, Buehl and Pyle, Ruckensteiner, and Bailey.

Scammon (17) had presented in his section of Morris' *Human Anatomy* a schema of the development of the skeleton of the extremities from J. G. Graca and C. R. Noback, who are not listed among his references. Other workers generally included no newborn infants in their studies, did not study the bones of the hands, wrists, knees, feet, and ankles, or made no reference to race or color of those under investigation.

Thus, it is seen clearly that, while skeletal growth as determined by the status of ossification of bones in the wrist and hand, knee, and foot and ankle seems to depend to some degree upon racial origin, the standards commonly used today may not be applicable, properly, to infants born of Negro parents.

The purpose of this paper is to present the status of ossification as indicated by the roentgenographic demonstration of the primary ossification centers for the bones of the foot and hand, and the epiphyses for the proximal tibia and distal femur, in newborn infants of Negro parentage and to relate these findings to sex, weight, length, parity, length of gestation period, prenatal maternal nutrition, age and height of the mother, socio-economic grouping of the parents, and skin color and reflex maturity index of the infant.

MATERIALS AND METHODS

This study covered 481 male and 516 female infants born of Negro mothers at the George W. Hubbard Hospital, Nashville, Tenn., between 1951 and 1958. The socio-economic status of the majority of

these mothers was ascertained prior to delivery. The height of the mother was measured by the social worker twenty-four to seventy-two hours after delivery. The length of the gestation period was determined from the date of the last menstrual period by standard methods of estimation. In the literature, descriptions will be found outlining the methods which were employed in classifying the individuals according to birth weight (18), prenatal nutrition scoring (19), socio-economic status (18), color of infant (20), and reflex maturity index (20).

For measuring the length of the infant, a sliding anthropometer was used. Uniformity in procedure was emphasized. In the initial phases of the study, more than one examiner checked the child's length. The small differences in the results obtained were comparable to the variations observed when the same examiner made two or more measurements on a given infant on the same day. These infants, after study of the distribution of their birth lengths, were placed in groups arbitrarily established according to these measurements.

The presence or absence of certain centers of ossification at the knee, foot and ankle, and hand and wrist, as detected on roentgenograms, was recorded in all cases. These regions were chosen because roentgen visualization of their ossification centers begins to occur at approximately nine calendar months' gestational age, and because they are the parts most frequently included in studies of this type.[3] The centers selected were those for:

The distal femoral epiphysis (also referred to here as "femur")
The proximal tibial epiphysis (also referred to here as "tibia")
The cuboid
The primary center for the middle phalanx of the fourth toe (also referred to here as "fourth toe")
The primary center for the middle phalanx of the fifth toe (also referred to here as "fifth toe")
The capitate
The hamate

In the areas studied, these were the only ossification centers which varied as to presence or absence on the roentgenogram. With a single exception, the remaining centers were either consistently present or consistently absent; the center for the third cuneiform was visualized in 60 out of 997 cases, an incidence of 6.0 per cent.

Roentgenograms were obtained for 852 infants between twelve and seventy-two hours after birth, and for the remaining 145 (14.5 per cent) under or over this age range. Those in the latter group were analyzed to determine whether their inclusion in the study could be justified. Of 61 males and 84 females, 42.8 per cent were radiographed when they were less than twelve hours old; 42.8 per cent when between seventy-three and one hundred sixty-eight hours of age; and 14.4 per cent, when older than one hundred sixty-eight hours. The percentages in respect to the total group (997) were 6.2, 6.2, and 2.1. The median age of those less than twelve hours of age at the time of radiography was 8.7 hours, whereas the median for those examined later than seventy-two hours postpartum was 79.2 hours (3.3 days). These 145 cases were analyzed for the presence or absence of various ossification centers and compared with the remaining 852 cases. Statistical analysis of the findings showed that the degree of nonuniformity in age at the time of radiography as found in this material does not distort the results significantly. It was felt, therefore, that the inclusion of these 145 infants in the study was justifiable.

The projections employed were: foot and ankle, anteroposterior; wrist and hand, postero-anterior; knee, postero-anterior. Adhesive tape was used to fix the

[3] The one exception is the inclusion of the primary center for the middle phalanx of the fourth and fifth toes. This center was chosen for the first reason only (Holmes and Ruggles, 21).

TABLE I: RESULTS OF CHI-SQUARE TESTS FOR ASSOCIATION BETWEEN PRESENCE OR ABSENCE OF SPECIFIED OSSIFICATION CENTERS AT BIRTH AND: (1) LENGTH OF GESTATION, (2) REFLEX MATURITY INDEX, (3) BIRTH LENGTH, (4) SKIN COLOR OF INFANT, (5) PARITY, (6) HEIGHT OF MOTHER, (7) PRENATAL NUTRITION ROUGH SCORE, (8) AGE OF MOTHER AT DELIVERY, (9) SOCIO-ECONOMIC GROUP, (10) BIRTH WEIGHT, AND (11) SEX OF INFANT

Ossification Center	Length of Gestation		Reflex Maturity Index		Birth Length		Skin Color of Infant		Parity		Height of Mother	
	M	F	M	F	M	F	M	F	M	F	M	F
Hamate	0	0	—	0	2%	1%	0	—	0	5%	0	—
Capitate	1%	—	—	—	1%	0.1%	0	0	0	5%	0	—
Tibia	—	2%	—	0	0.1%	0.1%	0	*	0	—	—	—
Femur	0.1%	*	0	0	0.1%	2%	0	—	0	0	0	0
Cuboid	0	—	—	0	0	0.1%	0	0	0	0	—	—
5th Toe	0	0	0	0	0	0	0	0	0	0	0	—
4th Toe	0	0	—	0	0	0	*	0	0	0	0	—

Ossification Center	Prenatal Nutrition Rough Score		Age of Mother at Delivery		Socio-economic Group		Birth Weight		Sex of Infant
	M	F	M	F	M	F	M	F	—
Hamate	0	*	0	0	0	—	—	0.1%	—
Capitate	*	0	0	0	0	—	5%	0.1%	—
Tibia	—	—	0	0	0	0	0.1%	0.1%	1%
Femur	0	0	0	0	0	*	*	*	2%
Cuboid	—	0	0	0	0	0	0.1%	0.1%	0.1%
5th Toe	0	0	0	0	—	0	1%	—	—
4th Toe	0	0	0	0	—	0	—	0	—

Key to Symbols: 0 = No consistent association; — = Consistent but not significant association; * = Could not make test due to small number of frequencies in some cells, but consistent association observed. 5%, 2%, 1%, 0.1% = Level of statistical significance.

NOTE: No attempt was made to test association where no consistent pattern was observed.

part to the cassette. The exposure factors were 45 to 55 kvp (depending on the part studied and its size), 36 inches focus-film distance, 50 ma, 1/20 second. Standard processing procedures were employed. Both sides were radiographed simultaneously. The usual technics and precautions were used to minimize radiation exposure.

Analysis of films of a sample of 60 males and 60 females, with consideration of all seven ossification centers, showed that in only 3.4 per cent of the 840 assessments was either the right or the left center present and the one opposite absent. The percentages were 2.61 and 4.3 for males and females, respectively. The greatest incidence of "split absence"[4] among the centers was found for the middle phalanx of the fifth toe: 8.3 per cent. In all cases, however, "split absence" was about equally divided between the "right absent-left present" and the "right present-left absent" groups, so that, from the standpoint of presence and absence only, it did not seem to matter which side was used. Accordingly, data from the right extremity were arbitrarily selected for this study.

Since there were seven centers assessed in each infant, the total number of assessments was 6,979 on the right side. Of these, 109 (1.6 per cent) were listed as unsatisfactory or questionable and were excluded from the study.

RESULTS AND DISCUSSION

It is well recognized that accurate determination of the level of maturity in the newborn cannot be accomplished through a single measurement. Some factors, however, are more useful in this respect than others. Further, these indicators of maturity are so interrelated that it is difficult, if not impossible, to weight them in proportion to their relative value.

The frequency with which specified ossification centers were present at birth,

[4] "Split absence": present on one side, absent on the other.

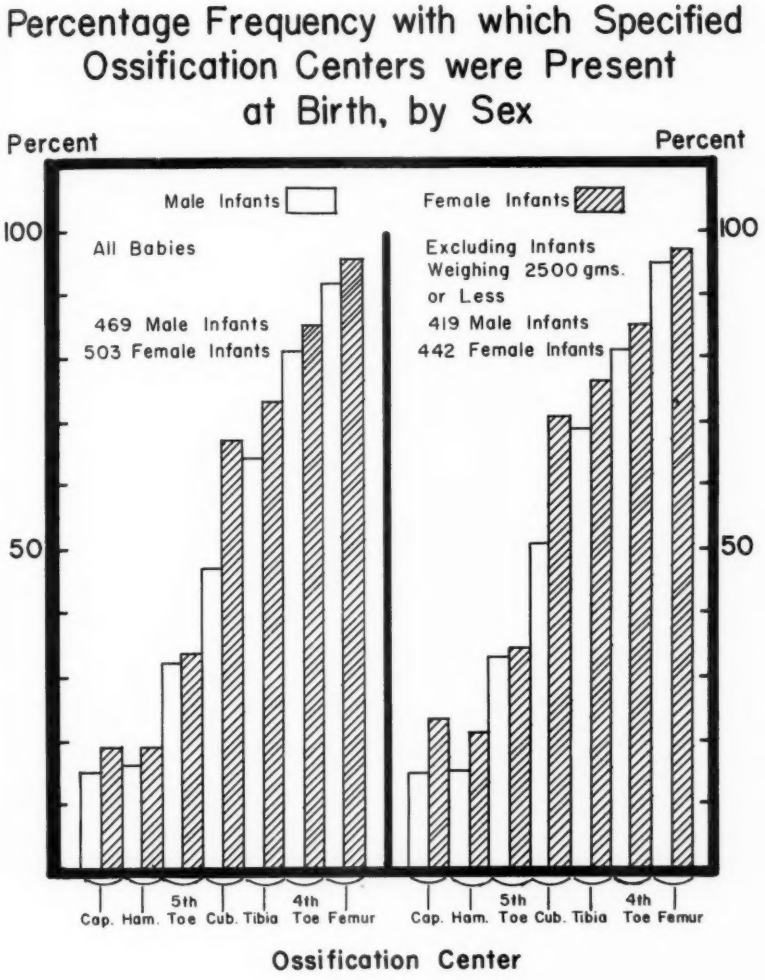

Figure 1

according to sex, is summarized in Figure 1. The number of infants included for each center varied from 972 to 996.

The results of Chi-square tests for association of presence of specified ossification centers at birth with other conceivably related factors (sex, birth weight, birth length, parity, length of gestation, prenatal maternal nutrition, maternal age, maternal height, socio-economic status, skin color of infant, and reflex maturity index) are summarized in Table I. The percentages indicating the presence of individual centers which show association with these factors at levels of statistical significance between 5 and 0.1 per cent are illustrated in Figures 2, 3, 5, 6, and 7. These factors, respectively, are: sex, birth weight, birth length, parity, and length of gestation period.[5] The latter two exhibited less significant association with ossification than did the others.

[5] The absence, in these figures, of representation of one sex or of one or more ossification centers indicates the absence of significant association in these instances. Likewise, no illustrations are presented when there occurred no significant correlation of factors with ossification.

Percentage Frequency of Ossification Centers in Newborn Infants, Significantly Associated with Sex of Infant

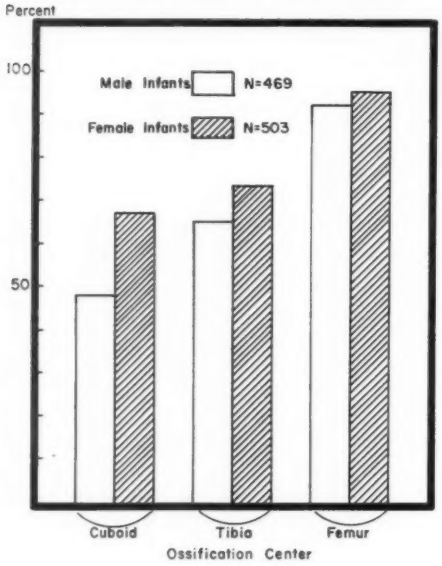

Figure 2

Sex: The number of infants included for each center varied from 972 to 989 (Fig. 2). All centers were present with greater frequency in females. This difference was most marked for the cuboid, with the proximal tibia next and, finally, the distal femur. This osseous precocity of females occurs in spite of the fact that in this series the males were heavier (19). While the frequency of ossification centers is higher in heavier and in longer infants of each sex, it is also higher for females than for males in the same weight category, and for females than for males in the same length category (Figs. 3 and 5).[6] This indicates that increases in weight or length alone are not the cause or effect of increase in ossification rates. These findings for weight obtained in other series (1, 2, 19).

Weight: The number of infants included for each center varied from 975 to 997 (Fig. 3). Although infants weighing 2,500 grams or less are included in this study, they merely depress the incidence of all centers for both sexes and do not change the order of frequency rates (Fig. 1). A definite increase occurred in the frequency of centers as the birth weight increased (Fig. 3). This was least marked

Percentage Frequency of Ossification Centers in Newborn Infants, Significantly Associated with Birth Weight

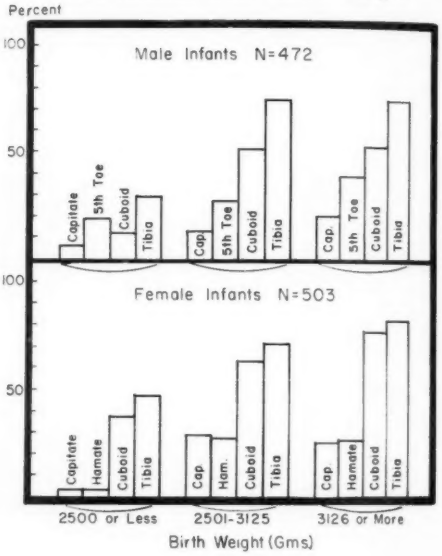

Figure 3

for the middle phalanx of the fourth and fifth toes (Table I). The rate of increase was approximately equal for both sexes.

The order of frequency rate of the ossification centers paralleled the order of appearance of these centers (where similar centers are assessed) as reported in the literature describing the progression of ossification changes during the prenatal period and early infancy (8, 21, 22). That this should be so is also implicit in the fact that the ossification within the center progresses by increases in ossified volume. In this respect, it is probable that the sigmoid appearance-rate curve for the individual center varies significantly

[6] Male:female mean birth length = 48.6:48.2 for 477 males and 513 females.

with that for other centers only *in time*, by reason of the probability that the magnitude of the arcs of the curve is closely similar for the different centers. Evidence of this is illustrated in Fig. 4.

Length: The number of infants included for each center varied from 977 to 995

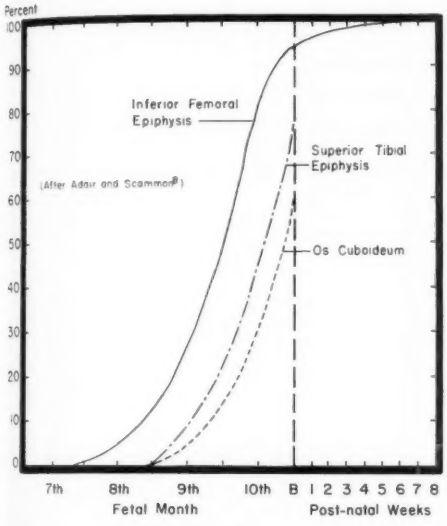

Figure 4

(Fig. 5). Similarly high levels of significance were found to exist between the presence of ossification centers and birth length. There was a tendency for the rate of increase in the frequency of the centers (especially those for the proximal tibia and distal femur) to taper off as the length of the infant increases.

Parity and Gestation: The number of infants included for each center varied from 504 to 509 for parity studies (Fig. 6), and from 903 to 913 for length of gestation period (Fig. 7). The association between various parity levels and the frequency of appearance of the ossification centers was determined. The tendency toward an increased incidence of a center as parity increased existed at the lowest level of significance (5 per cent), and only for the capitate and hamate of females. For males, there was no significant association with parity. Length of gestation showed

Percentage Frequency of Ossification Centers of Newborn Infants, Significantly Associated with Birth Length

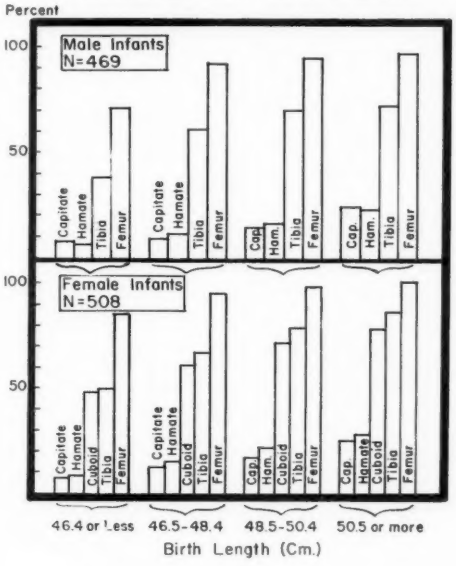

Figure 5

somewhat closer association with the appearance of ossification centers.

Where the Chi-square test could be applied (Table I), the reflex maturity index (747 infants), skin color (756 infants), height of mother (747 infants), prenatal nutrition score (439 infants), age of mother at delivery (816 infants), and socio-economic grouping (775 infants), exhibited no statistically significant association in either sex. For additional data regarding these and other factors in our series, the reader is referred to the works of Crump and associates (18–20, 23).

The centers for the middle phalanx of the fourth and fifth toes show no measurable or significant association with any of the factors, except that the center for the middle phalanx of the fifth toe was associated with birth weight in males (significant at 1 per cent) (Table I).

SUMMARY

1. The frequency of appearance of certain ossification centers in 481 male and

Percentage Frequency of Ossification Centers of Newborn Infants, Significantly Associated with Parity

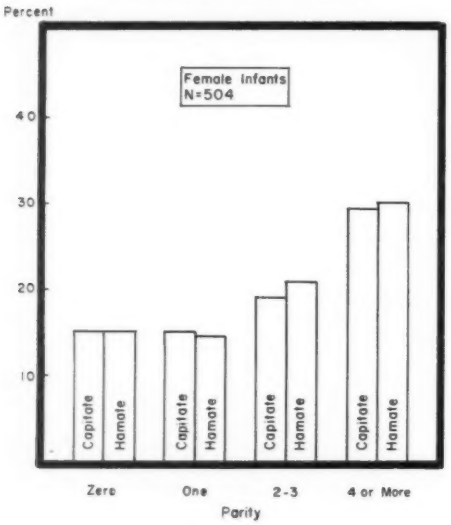

Figure 6

516 female Negro newborn infants is presented, supplementing a relative dearth of information on the subject.

2. The frequency of appearance of the centers studied was found to be significantly associated with birth weight, birth length, parity, length of period of gestation, and sex.

3. No significant association was found with reflex maturity index or skin color of infants, or with prenatal nutrition, socio-economic status, age, or height of the mothers.

4. As was to be expected, there was found a definite precocity of osseous development in females as determined by the frequency of appearance of ossification centers; this obtained for all the centers studied.

5. The descending order of frequency of appearance was:

For centers in males: the distal femur, middle phalanx of the fourth toe (primary center), proximal tibia, cuboid, middle phalanx of the fifth toe (primary center), hamate, capitate.

For centers in females: the distal femur, middle phalanx of the fourth toe (primary center), proximal tibia, cuboid, middle phalanx of the fifth toe (primary center), hamate, capitate.

The hamate:capitate frequency ratio in males was 16:15; in females it was 19:19.

6. This order of frequency parallels the order of appearance of these centers as reported in the literature for the neonatal period and early infancy.

Percentage Frequency of Ossification Centers of Newborn Infants Significantly Associated with Length of Gestation

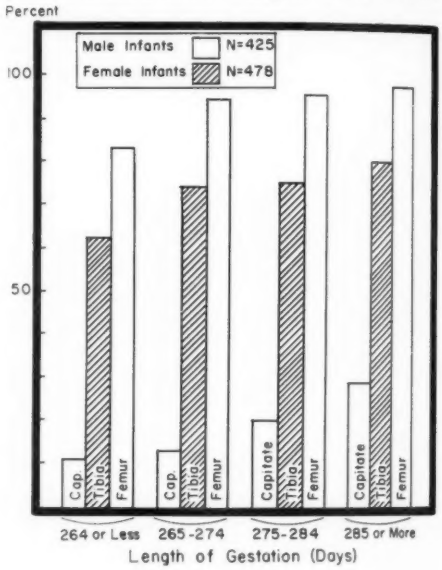

Figure 7

7. Infant factors showed a higher level of association with ossification, as herein described, than did those of maternal origin.

8. Except for an association with birth weight in the case of the center for the middle phalanx of the fifth toe, there was no measurable or significant correlation between this segment or the center for the middle phalanx of the fourth toe, and the factors included in this study.

Meharry Medical College
Nashville 8, Tenn.

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SUMMARIO IN INTERLINGUA

Crescentia e Disveloppamento: Le Relation Inter le Disveloppamento Ossee in Neonate Infantes Negre e le Sexo, Peso, Longor, Color Cutanee, e Maturitate Reflexe in le Infante Mesme e Factores in le Matre del Typo de Numero de Parturitiones, Duration del Periodo de Gestation, Nutrition Prenatal, Etate, Grandor, e Stato Socio-Economic

Esseva studiate le frequentia de certe centros de ossification in 481 mascule e 515 feminin infantes neonate negre. Le centros esseva le epiphyse femoral distal, le epiphyse tibial proximal, le cuboide, le centro primari pro le phalange medie del quarte digito del pede, le centro primari pro le phalange medie del quinte digito del pede, le capitato, e le hamato. Esseva trovate que le frequentia del apparition de iste centros es significativemente associate con le peso natal, le longor natal, le numero de previe parturitiones, le duration del periodo de gestation, e le sexo. Nulle significative association esseva trovate con le indice del maturitate reflexe o le color cutanee del infante o le nutrition prenatal, le stato socio-economic, le etate, o le grandor del matre.

Como expectate, un definite precocitate del disveloppamento ossee esseva constatate in femininas. Isto valeva con respecto a omne le centros studiate.

Factores in le infante esseva associate plus nettemente con le ossification que factores a base in le matre.

Growth and Development of Bone, Normal and Abnormal

Including a Section on Rickets[1]

HOWARD J. BARNHARD, M.D., and ROBERT W. GEYER, M.D.

THE STUDIES of living bone to be presented here were performed with the roentgenographic time-lapse method. This approach is basically an adaptation and combination of conventional time-lapse and animated cartoon procedures (2). The results as they concern normal growth and development will be presented, and some interesting findings on bone thinning and rickets will be discussed. The composite illustrations show only a small sample of the roentgenograms made during the course of each experiment. These appear to be the best compromise in lieu of the motion picture studies themselves.

The roentgenographic time-lapse method has been described in detail elsewhere (3). In brief, the bones of the dog's foreleg are pinned with a device developed to permit accurate repositioning of the limb as interval exposures are made every four to eight hours. When photographed on motion picture films and projected, the slight changes between roentgenograms impart motion to the viewed image. The roentgenograms thus serve the same purpose as do the multiple drawings of the cartoonist, and weeks or months of change

Fig. 1. Modified crossbar with one pin at each end positioned in holding unit for roentgenographic study. Note alert co-operative puppy. The insert shows details of crossbar which has one limited adjustment end.

[1] From the Departments of Radiology, The University of Arkansas Medical Center, Little Rock, Ark., and the Hahnemann Medical College and Hospital of Philadelphia. Presented at the Forty-Fifth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 15-20, 1959. This work was supported in part by Grant #A-4512, National Institutes of Health (Institute of Arthritis and Metabolic Diseases).

are compressed into minutes, as in conventional time-lapse studies.

The use of puppies in these studies necessitated reduction in bulk and weight of the metallic appliance fixed to the leg. To accomplish this reduction, the holding (cross) bar was made smaller, and only one pin was used at each end of it (Fig. 1). The failure rate has thus unavoidably been increased, since a single pin is more likely to become loose in the bone than are two or three. The animals were not used until six weeks of age. By that time they are weaned and their bones are large enough for placement of pins in them.

NORMAL GROWTH AND DEVELOPMENT

At approximately six weeks of age,[2] the distal radial epiphysis is well developed, but the associated ulnar epiphysis is usually not present (Fig. 2). Between the seventh and ninth week, the distal ulnar epiphysis blossoms from faint calcification to a well formed dense structure. It is difficult to equate this time period with that in man. If we arbitrarily assume that growth to approximately full stature requires nine months in dogs and eighteen years in *Homo sapiens*, the two-week epiphyseal growth period in dogs would be the equivalent of one year in a human being. There are several reports relating epiphyseal appearance and fusion in man to age. We are not aware, however, of any studies in which individual epiphyseal centers have been followed in the same individual.

For the most part, longitudinal growth, circumferential growth, and remodeling occurred as expected. As longitudinal growth proceeds, the trabecular pattern appears to "flow" in a very orderly manner, as its relative position changes from zone of provisional calcification through metaphysis to diaphysis. The impression is gained that the trabeculae follow a prearranged pathway rather than reacting to change imposed by stress or alteration in form. This observation tends to reaffirm the fact that Wolff's law applies only to adaptive circumstances beyond the range of normal development.

[2] The precise age of the dogs was not always known but is probably accurate within ± 1 week.

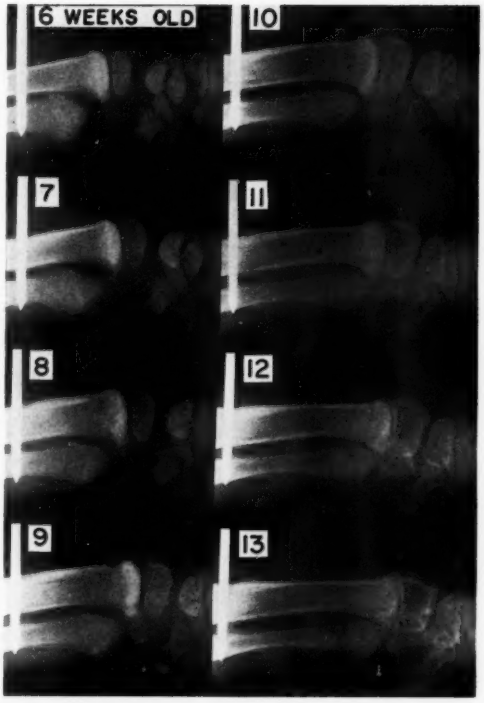

Fig. 2. Growth and the calcifying distal ulnar epiphysis at weekly intervals. Note also the developing carpal bone described as the accessory bone in veterinary literature (5); it is the inferiormost bone in each picture, showing faintly at the seventh week.

ULNAR THINNING

A rather interesting finding has been ulnar thinning distal to the pins (Fig. 3). This thinning occurs with regularity when the leg is pinned early and the growth phase is followed over several months. As observed in the motion picture study, the ulna undergoes a change which resembles a wad of bubble gum being drawn from a child's mouth; that is to say, the increasing length appears to take place at the expense of decreasing diameter. The thinning occurs gradually at first and then speeds up considerably. Metaphyseal narrowing takes place last and most rapidly.

This phenomenon is associated with two other features: radioulnar synostosis

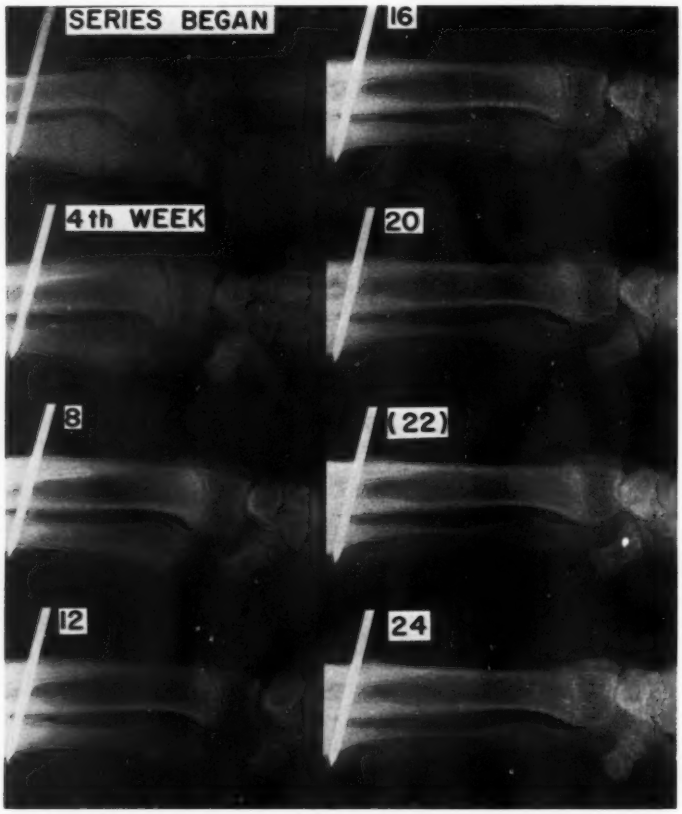

Fig. 3. Ulnar thinning. This series began at 16 ± 2 weeks of age and demonstrates growth over the ensuing six months. The ulnar thinning is a striking feature, discussed in the text. Note that the twenty-second week interrupts the sequence to show intermediate detail and that the narrowing proceeds rapidly after the sixteenth week.

and "bending" of the radius beyond the pins toward the thinning ulna. The synostosis is easily explained. Circumferential growth eventually results in the meeting and fusion of adjacent cortices, because normal drifting apart of the bones is prevented by the restraining pins. This fusion may bear considerable relationship to the ulnar thinning. One effect is that weight-bearing is transferred from the ulna to the radius at the synostosis rather than throughout the greater length of the interosseous membrane. This "lack of function" of the distal ulna may have led to its atrophy.

Because of the possibility of vascular occlusion, bilateral femoral arteriograms were obtained in one animal. The involved side showed a pronounced increase in the anastomotic channels proximal to the pins. In addition, the vessel that we presume to be the interosseous artery was smaller than on the normal side.

Another theory develops if we consider the fact that the radius bends toward the ulna much like a bow bent by its string. If the growth of the ulna is somehow selectively slowed by the pins, it might cause the more rapidly growing radius not only to bend but also to "pull out" the ulna. Constant pull of a related sort has been reported to exert such an effect when applied to the olecranon process (4). However, the change was

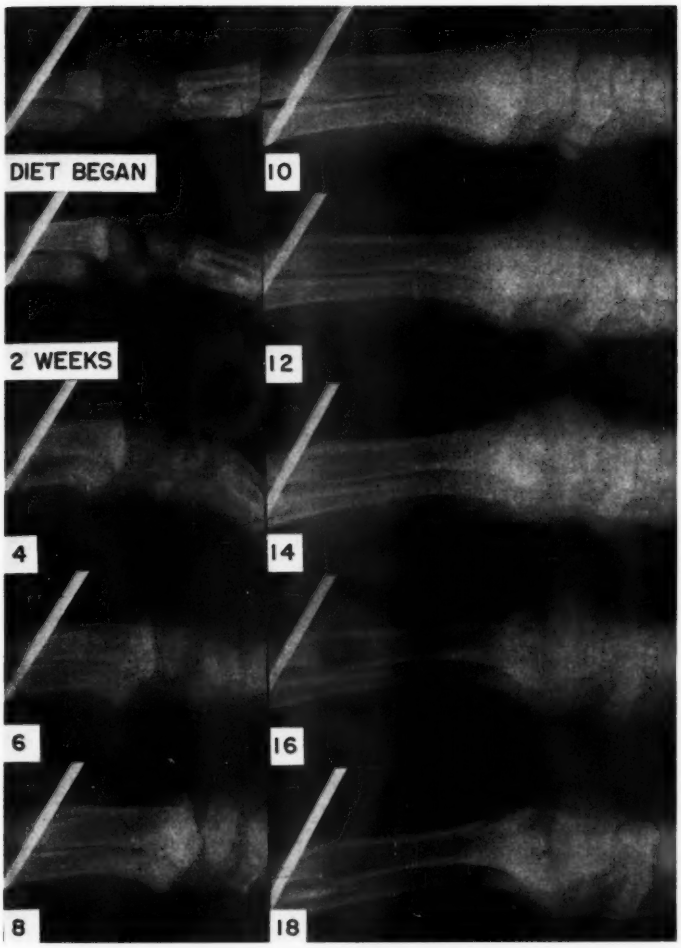

Fig. 4. Rickets. The distal epiphysis of the radius is at first tight against the metaphysis. The radiolucent zone of provisional calcification gradually increases to become maximal between four and five weeks. At ten weeks it has collapsed, but thereafter the broadened radiolucent zone and other rachitic changes become more marked than ever. This dog was 6 ± 1 weeks old when the vitamin D deficient diet was started.

not as pronounced as that shown here.

There are, then, several theories regarding the mechanism whereby ulnar thinning develops. Further studies along these lines may shed light on such entities as congenital bone deformity, idiopathic vanishing bone disease, and atrophy of bone associated with anterior poliomyelitis.

RICKETS

"In rickets, the formation of a provisional line of calcification cannot occur, and the columnated cartilage cells behave as though a restraining influence had been removed. They proliferate and persist until large, irregular masses of cartilage widen the epiphyseal lines and extend into the metaphysis, there to mingle with the patches of osteoids in an irregular, patternless aggregate."

". . . any osteoid which is deposited is laid down along this irregular line of ossification in the metaphyseal zone. Attempts at ossification of the irregularly

deposited osteoid enhance the regularity of the metaphyseal region, which results in a radiographic appearance which has been compared to the bristles of a paint brush."

These quotations from Aegerter and Kirkpatrick's recent book, "Orthopedic Diseases" (1), reflect, in substance, the generally accepted thinking on rickets. Without question, the radiolucent zone which develops between the epiphysis and metaphyseal end is this zone of provisional calcification in which calcium has not been laid down. Further, one would conclude from the literature that this process is relatively static, in that the proximal (metaphyseal) end of the zone of provisional calcification remains stable as the epiphysis is pushed farther and farther away. The epiphyseal displacement would occur as more uncalcified and therefore radiolucent osteoid is laid down.

In our dog series (Fig. 4) we were surprised, therefore, to find that the radiolucent zone which developed in the earlier phase of rickets tended to remain the same width for a time, even though the bone grew longer. Later, there occurred a very abrupt decrease in this radiolucent zone, explained apparently by the fact that the active animal crushes the epiphysis into the zone of provisional calcification (6).

As viewed on motion picture study, the appearance was that of a race between the epiphysis and end of the shaft. At first, as the radiolucent zone broadened, the epiphysis would seem to be winning; then the lead of the epiphysis over the metaphysis would remain the same, and suddenly the metaphysis would appear to catch up. The late stages of rickets could not be satisfactorily recorded on motion picture film since the pins became loose in the severely demineralized bone.

These findings suggest that, at least in mild or early rickets, the "older," proximal part of the zone of provisional calcification undergoes delayed calcification even though the radiolucent zone persists. Because of the dog's more rapid growth rate, this factor is undoubtedly more easily seen than in the man. In addition, such a finding may easily be missed without a point of reference, such as the pins, and without the attention-gaining mechanism of the motion picture study. That this feature has previously been overlooked should not, therefore, be considered as negating its accuracy.

Figure 4 appears to demonstrate delayed appearance of epiphyseal centers in comparison with Figure 2. We cannot be certain that this is entirely a rachitic effect, since we were using mixed breeds and variations in time of appearance exist between breeds (5).

SUMMARY

Normal epiphyseal development and growth of bone in dogs was demonstrated by roentgenographic time-lapse studies.

An interesting, incompletely explained bone thinning may furnish a clue to similar findings in congenital abnormalities, disuse atrophy, and, perhaps, idiopathic vanishing bone disease.

Rickets, at least in its early phase, is a less static process than was formerly thought. Growth continued even though the zone of provisional calcification remained broadly uncalcified.

NOTE: Of the many who have played some part in this project, we would like to acknowledge in particular the considerable help of our research assistant, Mr. Hosea Hardin.

University of Arkansas Medical Center
Little Rock, Ark.

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SUMMARIO IN INTERLINGUA

Crescentia e Disveloppamento de Osso, Normal e Anormal, con un Section Super Rachitis

Esseva studiate le crescentia e le disveloppamento del ossos del gamba anterior de canes per medio del methodo de roentgenographia chrono-acceleratori. In canettos de sex menses de etate, le epiphyse radial distal es ben disveloppate. Inter le septime e le none septimana, le epiphyse ulnar distal progrede ab le stadio de vage calcification ad illo de un ben-formate dense structura. Le impression esseva que le trabeculas seque un programma predisponite e non reage simplemente a alterationes imponite per stresses e modificationes de forma.

Un observation de interesse esseva le tenuification ulnar distal al puncto de application del clavos retenente le gamba stabile pro le examine. Iste phenomeno, que es associate con synostose radio-ulnar e "curvation" del radio, non es completemente explicate, sed le opinion pare justificate que illo provide un indicio pro le explication de simile constatationes in anormalitates congenite, in atrophia per non-usation, e forsan in idiopathic morbo de osso atrophiante.

Esseva monstrate que rachitis, al minus in su phases precoce, es un processo minus static que lo que esseva credite in le passato. Le crescentia continuava ben que le zona de calcification provisori remaneva largemente acalcific.

Intra-Aortic Nitrogen Mustard for the Palliation of Advanced Pelvic Cancer[1]

G. M. STEVENS, M.D., S. F. THOMAS, M.D., and B. C. WILBUR, M.D.

A FEELING OF despair grips each of us when we face the problem of the management of intractable pain and pressure symptoms due to advanced incurable pelvic cancer. At this point the life expectancy may be brief, finances are depleted, and the patient's courage is nearly exhausted by the unrelenting course of his disease. In the interest of diminishing or alleviating the symptoms in the most rapid, least traumatic, and least expensive way possible, we have utilized nitrogen mustard introduced into the aorta in the manner to be described. Our experience in treating 52 patients over a seven-year period will be recounted here.

The systemic use of HN_2 has had widespread and beneficial application for many years. Our interest in its more localized and concentrated use by the arterial route was stimulated by the report of Klopp and associates in 1950 describing the experimental treatment of malignant tumors (17). Their experimentation followed the accidental intra-arterial administration of HN_2 and the recognition of its potentiality. In animals they have shown radiomimetic tissue changes following the arterial distribution of nitrogen mustard, which could not be reproduced by intravenous doses of even lethal amounts of the drug. The rapid alleviation of symptoms in certain patients is consistent with the experimental evidence of Sugar and Kellner (21) that some cellular effect appears as early as ten minutes after injection of nitrogen mustard. The evidence of nuclear injury is seen microscopically in thirty to sixty minutes (21). Klopp states that the maximal microscopic cellular effect is demonstrable in twelve to twenty days. He observed some clinical reduction in the size of cervical and vaginal tumors approximately four days after intra-aortic injection of HN_2 and a marked effect in eight days (18). The rapidity of action as compared with conventional radiation therapy provides an advantage which can well be utilized in dealing with intractable pain and pressure symptoms. Advanced malignant tumors of the head and neck, extremities, skin, and liver, as well as of the pelvis, have been treated with intra-arterial nitrogen mustard (4, 9, 13, 20). In those patients with sufficient life expectancy, if the skin tolerance dose has not been surpassed, the combined use of intra-aortic HN_2 and external roentgen therapy has sound theoretical and experimental support (2, 3, 14, 16, 23). Fourteen cases receiving combined therapy are included in our group.

METHOD

The intra-aortic administration of nitrogen mustard is carried out on a radiographic table in the radiology department approximately one hour after premedication with Demerol or scopolamine. General anesthesia is usually not needed.

Procedure outline (Fig. 1):

1. Pneumatic tourniquets placed on midthighs.
2. Groin prepared and draped.
3. Local anesthetic administered over femoral artery puncture site as well as periarterially.
4. Skin incised and femoral artery punctured with No. 16 needle and attached Luer-Lok ring control syringe.
5. One per cent Procaine, 2 to 4 c.c., injected into femoral artery.
6. Polyethylene catheter, No. 60, threaded through needle up into aorta.
7. Catheter position checked radio-

[1] From the Department of Radiology (G.M.S. and S.F.T.) and Surgery (B.C.W.), Palo Alto Medical Clinic, Palo Alto, Calif. Accepted for publication in May 1960. This paper was presented in part at the meeting of the California Medical Association, February 1959.

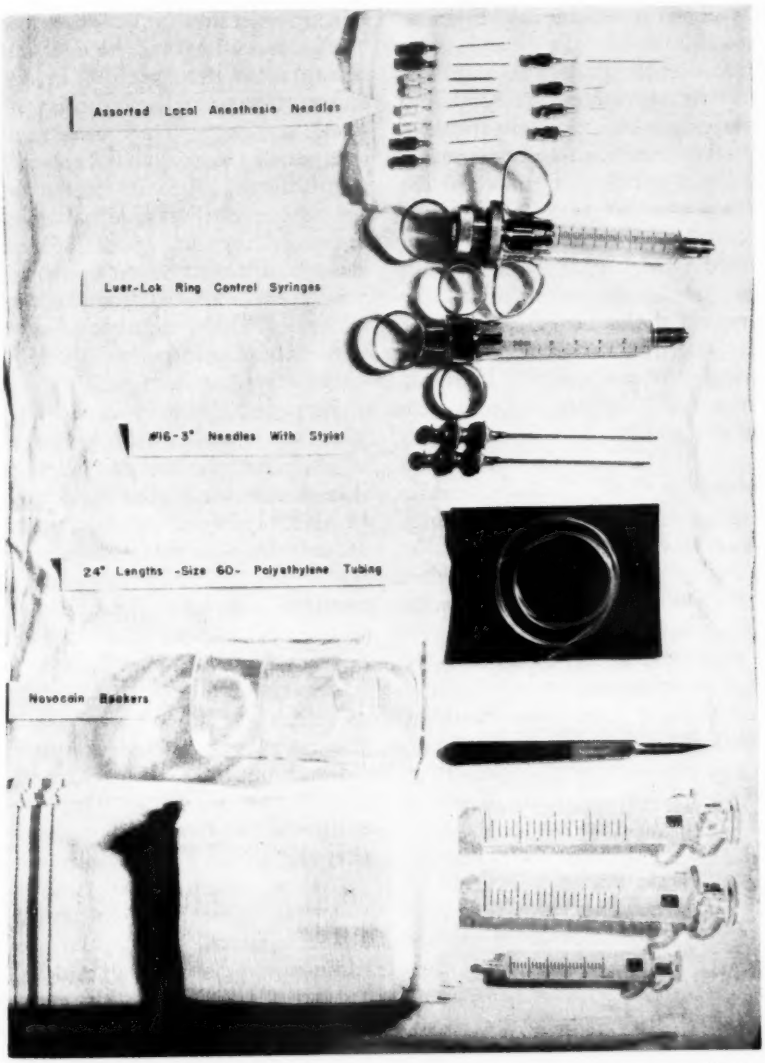
Assorted Local Anesthesia Needles
Luer-Lok Ring Control Syringes
#16-3" Needles With Stylet
24" Lengths -Size 60- Polyethylene Tubing
Novocain Beakers

Fig. 1. Equipment required for intra-aortic injection of nitrogen mustard for palliation of pelvic cancer.

graphically by contrast-agent injection, then correction made to inject HN_2 at about level of second lumbar interspace.

8. Pneumatic thigh tourniquets inflated to occlude arterial flow.
9. Twenty mg. nitrogen mustard in 10 ml. saline rapidly injected.
10. Tourniquets deflated in three minutes.
11. Catheter and needle removed as a unit.
12. Pressure dressing applied.
13. Antiemetic drugs administered.

Comments on Method: Intra-arterial procaine prior to injection of the nitrogen mustard is believed to diminish the likelihood of arterial spasm and for this reason is given prophylactically. The catheter tip is intended to be below the level of the renal and superior mesenteric arteries and above the inferior mesenteric vessels and bifurcation. The lower border

of L-2 generally is a satisfactory injection level.

If an opaque catheter is not available, a small amount of radiographic medium should be injected to check the position of the catheter. Its dimensions prevent administration of a bolus of sufficient size to opacify the aorta and its tributaries.

At the conclusion of the injection of HN_2 the needle and catheter are simultaneously removed to prevent the inadvertent shearing off of the latter and its loss intra-arterially. In general, there is little discomfort with the procedure. The principal complaint is the tightness of the tourniquets.

CLINICAL EXPERIENCE AND RESULTS

The patients included in our group, with rare exceptions, had gross discomfort or intolerable symptoms of pain and/or pressure from advanced malignant disease involving the pelvis. In nearly all, the life expectancy was short, surgery was out of the question, and narcotic effectiveness was diminished; in some radiation had been administered to the limit of skin tolerance. Several tumor types were represented, as follows:

Tumor Type	*No. of Patients*
Adenocarcinoma of colon	14
Adenocarcinoma of uterus	5
Squamous-cell carcinoma of cervix	11
Adenocarcinoma of ovary	9
Transitional-cell carcinoma of bladder	4
Miscellaneous (6 radioresistant)	9
TOTAL	52

A total of 83 intra-aortic injections of nitrogen mustard have been given to the 52 patients during the past seven years. In each case malignancy was proved pathologically. Twenty-three patients received more than 1 treatment, 1 having 6 injections in an eight-month period. The interval between injections varied from six days to nineteen months but in general was one to three months. Fourteen patients received a sandwich-type therapy, consisting of intra-aortic HN_2 followed by external roentgen therapy, then a second injection of HN_2 a month after the first. Inasmuch as no controls are possible, and the patient group is quite heterogeneous pathologically, no effort was made to assess the prolongation of life. Only the palliative response was judged.

Of the 52 patients treated, 24 experienced complete or marked relief of symptoms. Altogether, some measure of relief was obtained in 33. In 8 patients there was insufficient information for appraisal of palliation either because of early death or inadequate documentation of the effect in the record.

In general, the effect lasted for one to three or more months, though in a few cases, relief was limited to a few hours or days. The exact duration was often not precisely recorded or could not be definitely stated, since the reappearance of symptoms was gradual. It is, of course, difficult to evaluate subjective response when optimism of patient and doctor alike may be reflected in the palliative result. We have tried to assess the effect conservatively.

An effort was made to determine whether prior radiation therapy adversely affected the chances of good palliation. Thirty-one of the 52 patients had received such prior therapy, as against 21 who had not. The palliation achieved in the two groups was essentially the same, but the numbers are small, and the amount of prior irradiation varied considerably. In respect to the relative effect of successive intra-aortic HN_2 injections, we feel that in general the response diminishes somewhat with each administration.

The morbidity was slight, certainly less than is usually noted with intravenous HN_2, and generally lasted less than twenty-four hours. Anti-emetic drugs are believed to minimize symptoms and are used prophylactically. Maximal hematopoietic suppression is known to occur ten to fourteen days after intra-aortic nitrogen mustard injection. The dose and interval between treatments in this group of patients seldom resulted in the need for transfusions.

Special mention of the rapidity of action of the nitrogen mustard is in order. In some patients distinct and occasionally dramatic palliation of pain was noted almost immediately. This causes speculation as to primary damage to the sensory nerve receptors in such cases, in addition to the radiomimetic action on the tumor itself.

Objective evidences of tumor regression include palpable diminution in tumor size, visible regression of tumors (as reported by Klopp *et al.*), diminution or elimination of the demand for narcotics, and radiographic evidence of relief of ureteral obstruction.

In addition, postmortem studies have clearly demonstrated the chemotherapeutic effect on tumor in the treatment field as compared with tumor lying outside the arterial distribution.

Correlation Between Tumor Type and Palliative Results: Klopp has indicated that many tumors considered insensitive to external radiation therapy respond favorably to intra-arterial nitrogen mustard (17). Ariel (1) reported similarly favorable palliation in 23 patients with carcinoma of the bowel, who were treated with intra-aortic HN_2 and terramycin (the addition of the latter has since been discontinued, because of its irritating effect). Somewhat conflicting is the more recently reported experience of Krakoff and Sullivan (19), who found rectal carcinoma completely refractory to this type of therapy, though it was generally successful in other tumors which are customarily responsive to external roentgen irradiation.

Since 14 patients in our series had adenocarcinoma of the bowel, their response seems worthy of particular mention. Of the 14, 4 had dramatic, if not complete, relief of symptoms, 2 had marked relief, 4 were improved, 2 experienced slight or equivocal relief, and 2 were not helped. This surprisingly good response in a generally refractory tumor encourages us, and we hope others, to employ this procedure more often in the hope of transforming an otherwise desperate situation to a tolerable one.

A total of 16 patients who had carcinoma of the uterine body or cervix were given intra-aortic injections of nitrogen mustard. There was good palliation if not complete relief of symptoms in 10; 1 did not respond to treatment; in 5 cases the results were not clearly stated.

Other tumor groups were too small for valid conclusions, but striking improvement was seen in individual cases of carcinoma of the ovary, urinary bladder, Hodgkin's disease, and myosarcoma of the upper thigh.

Complications: Complications were surprisingly infrequent. Perhaps the most alarming was diffuse peripheral arteriospasm in the femoral artery after injection of HN_2 in 1 patient. Marked ischemia for a time appeared irreversible, but was rather promptly relieved after the injection of several cubic centimeters of 1 per cent procaine. It is for this reason that 1 per cent procaine is now injected periarterially and intra-arterially as a prophylactic measure.

Transient temperature elevation in 3 patients, all within a few hours after injection, lasted from one to four days.

In 1 patient there was a transitory hypertension of 230/120 which gradually returned to normal. It is believed that the injection was either above the renal pedicle or possibly near the orifice of an aberrant renal artery.

On 2 occasions the catheter curled upon itself during insertion. Both catheter and needle should be simultaneously removed to avoid shearing off of the catheter in the artery. The catheter is then reintroduced on the same side or in the contralateral femoral artery.

In several patients, post-puncture femoral artery bleeding was a minor problem but in each case was controlled by a pressure dressing.

Other writers have reported a distressingly high complication rate with indwelling catheter technics and/or much higher doses (up to 1.1 mg./kg.) than were

utilized in this group of patients (6, 7, 10, 15, 23).

DISCUSSION

There are an infinite variety of ways to deal with the problems of advanced pelvic cancer, all pitifully inadequate. Tractotomy has been advocated by some and alcohol injection of the sensory roots by others. Radiation therapy is another of the time-honored procedures which has been used alone and in combination with other methods. Byron and associates (8) administered HN_2 intra-aortically, at the time of exploration, to 34 patients, with far advanced pelvic cancer, after temporarily occluding the aorta, inferior vena cava, and femoral arteries. Recently, extracorporeal circulation perfusion technics with chemotherapeutic agents introduced into tourniquet-isolated tumor areas have been described by Creech, Ryan, and associates of Tulane University (11, 12). This method is being applied in many medical schools and centers. It requires open operation, elaborate apparatus, and a refined and practiced team approach.

We feel that the procedure which we have described has merit for the following reasons: The equipment is simple and available in any hospital; no general anesthesia or expensive surgical procedures are required; the morbidity is brief; hospitalization for only about twenty-four hours is necessary, and prompt palliation is obtained in many cases. In addition to symptomatic palliation, tumor regression may be produced or tumor extension thwarted, with prolongation of life and the will to live. Two of our patients in this group are alive and well six years after intra-aortic HN_2 injections. Others have survived for as long as four years, though a cause-and-effect prolongation of life is not established, since a control comparison is not possible in a clinical study of this type. It remains to be seen whether the isolation perfusion technics will provide greater palliation and a higher frequency of tumor arrests. Circulation isolation is technically quite difficult, if not impossible, in the pelvis.

CONCLUSION

1. Intra-aortic injection of HN_2 is a useful, safe, inexpensive, and rapidly acting palliative procedure in many cases of intractable pain and pressure symptoms due to pelvic cancer. Of 52 patients so treated, 24 had complete or marked symptomatic relief, 9 had slight relief, and in 19 there was either no relief or the effect was undocumented.

2. Many tumors usually classed as radioresistant respond favorably to intra-aortic HN_2.

3. Morbidity is minimal, usually lasting less than twenty-four hours.

4. Dramatic relief of symptoms is achieved in some cases.

5. Duration of relief varies from a few hours to several months.

6. The procedure can be safely repeated several times.

300 Homer Avenue
Palo Alto, California

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SUMMARIO IN INTERLINGUA

Intra-Aortic Mustarda de Nitrogeno pro le Palliation de Avantiate Cancere Pelvic

Le injection intra-aortic de mustarda de nitrogeno (HN_2) es un utile, salve, incostose, e rapidemente active mesura palliative in multe casos de intractabile dolores e de symptomas de pression causate per cancere pelvic.

Le autores describe lor methodo de injection que esseva usate 83 vices in 52 patientes in le curso de septe annos, con 23 patientes recipiente plus que un tractamento. Le casos includite in le serie esseva adenocarcinomas del intestino, del utero, e del ovarios, carcinoma a cellulas squamose del cervice, e carcinoma a cellulas de transition in le vesica. Occurreva marcate o complete alleviamento del symptomas in 24 patientes e un certe grado de alleviamento in un total de 33. In 8 le information non sufficeva pro un evalutation. In plure casos un distincte e occasionalmente dramatic palliation del dolores esseva notate quasi immediatemente post le tractamento.

Objectivemente il occurreva un palpabile diminution del dimensiones del tumor, un regression visual del tumor, un reduction in le demanda de narcoticos, e evidentia radiographic de alleviamento del obstruction ureteral. Studios necroptic demonstrava le effecto chimotherapeutic in le tumor intra le campo de tractamento in comparation con le tumor extra le distribution arterial.

Le morbiditate esseva pauco grave e durava generalmente minus que vinti-quatro horas. Drogas antiemetic que possede presumitemente le virtute de minimisar le symptomas es usate prophylacticamente. Complicationes esseva surprendentemente infrequente.

Le autores cita le sequente meritos de lor technica: Le equipamento es simple e disponibile in omne hospital; nulle anesthesia general e nulle costose manovras chirurgic es requirite; le morbiditate es breve; hospitalisation es necessari durante non plus que circa vinti-quatro horas; un prompte palliation es effectuate in multe casos; il es possibile repeter le mesura plure vices sin risco.

Orabilex and Pseudoalbuminuria[1]

LLOYD K. MARK, M.D., MORRIS MOEL, M.D., NORBERT ENZER, M.D., and EDITH VOLK, M.T.

PSEUDOALBUMINURIA following the performance of oral cholecystography is common. The frequency of this finding varies with the contrast agent and the laboratory tests employed. For all cholecystographic media, cold Exton's or Roberts' reagent gives a higher incidence of pseudoalbuminuria than does hot Exton's reagent or heat and acetic acid. Until recently iodoalphionic acid (Priodax), iopanoic acid (Telepaque), and iophenoxic acid (Teridax) were the cholecystographic media used almost exclusively in the United States. Seedorf and Powell (1, 2, 4) found an incidence of pseudoalbuminuria from 14 to 60 per cent occurring the day after oral ingestion of these media. In some patients this false positive test for albumin in the urine persisted for two to three days.

Recently Orabilex (5), a triiodo organic compound containing 57 per cent iodine, has gained wide usage in this country. Its chemical structure, physiological characteristics, and toxicity are similar to those of Telepaque. Tests for albumin on 0.75 grams of Orabilex, the amount in a single capsule, were highly positive with Roberts' reagent or with 3 per cent sulfasalicylic acid and negative with heat and acetic acid. Similar tests on Telepaque were negative.

In 25 patients in this study, tests for albuminuria were negative prior to administration of Orabilex, and positive on the morning of cholecystography, fifteen hours after the ingestion of 4.5 grams of Orabilex (6 capsules), with either Roberts' reagent or 3 per cent sulfasalicylic acid. Positive results ranged from 2+ to 4+ and were unrelated to the degree of opacification of the gallbladder. Only 1 heat and acetic acid test was positive. Twenty-four hours later tests were still positive in 3 patients, 1+ to 2+.

The significance of these findings is that Orabilex produces a transient pseudoalbuminuria due to renal excretion of the contrast media. Since Orabilex itself gives a highly positive test for albumin and is mainly eliminated through the urinary system, a positive test for albumin does not indicate renal disease or damage. Use of the heat and acetic acid test for albuminuria rather than Roberts' reagent or 3 per cent sulfasalicylic acid will usually avoid this false positive reaction.

948 N. 12th Street
Milwaukee 3, Wisc.

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[1] From the Departments of Radiology and Pathology, Mount Sinai Hospital, Milwaukee, Wisc. Accepted for publication in April 1960.

(Pro le summario in interlingua, vider le pagina 956)

A Vascular Injector with Program Selector[1]

KURT AMPLATZ, M.D.

A portable cardiovascular injector previously described (1) proved satisfactory for selective cardioangiography. For peripheral angiography and especially cerebral angiography certain features were lacking, which led to the development of a new device considered suitable for any type of angiographic work. Special emphasis has been placed on simplicity of construction, on operation, and especially on compactness, since floor space is limited in most x-ray rooms. The pertinent features of this injector are:

1. A small power source, namely, a carbon dioxide cartridge.
2. Use of glass syringes as well as a 55-c.c. stainless steel syringe for high pressure injections.
3. Pressure control ranging from minimal thrust up to very high pressure for selective cardioangiography.
4. Automatic heating control in a transparent syringe holder allowing observation of the syringe.
5. One single power cable leading to the x-ray machine.
6. Remote control from the control panel on the x-ray machine.
7. Built-in timer allowing multiple automatic x-ray exposures anywhere from the beginning of the injection up to 10 seconds delay.

Since regular glass syringes with a ground-glass piston tend to "freeze," special metal plungers were developed. These plungers have low friction and can be used with multifit BD glass syringes with no tendency to "freeze." The stroke is adjusted so that a few cubic centimeters of rest volume remain in the syringe, eliminating air injection. Obviously, air bubbles can be easily detected through the transparent well illuminated syringe holder.

A commercially available carbon dioxide cartridge is placed in a cartridge holder (A) (Fig. 1) and punctured. The carbon dioxide gas under a pressure of 750 to 800 pounds per square inch is released.

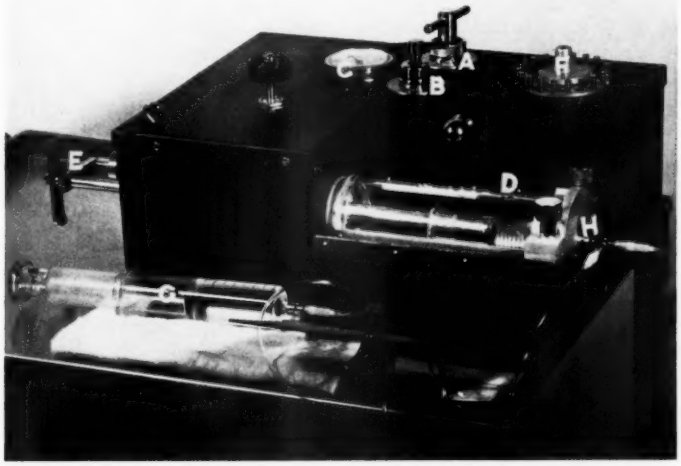

Fig. 1. Vascular injector for any type of angiographic work. See text for full description.

The desired pressure in the pressure cylinder is regulated by a reducing valve (B). The pressure is indicated in pounds per square inch on a manometer (C). (Example: Peripheral angiography 15 to 25 pounds, selective cardioangiography 200 to 280 pounds per square inch.) The syringe is filled with contrast medium and placed in the heated syringe holder (D), controlled by a thermostat. The first exposure is triggered from an actuator on the calibrated piston rod (E). Additional exposures can be set at half-second intervals on the mechanical timer (F). The injector is fired remotely from the x-ray control stand. A radiopaque timer is placed on the x-ray film; it is energized at the start of the injection indicating the exact time of exposure. After the injection, the syringe can be reloaded with contrast medium through the syringe (G) through a plastic tubing and three-way stopcock (H).

This type of reloading has proved to be simple and fast and therefore especially practical for cerebral angiography. The two-syringe system may be left

in place for the examination of several patients. For low injection pressures, as for peripheral angiography, 15 injections can be made with a single carbon dioxide cartridge.

The device has proved to be dependable, simple in operation, and well adaptable for any type of angiocardiography.[2]

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[1] From University of Minnesota Medical School, Minneapolis, Minn.

[2] Will be available commercially from Medmac, Inc., 708 42d Ave., N., Minneapolis 12, Minn.

SUMMARIO IN INTERLINGUA

Orabilex e Pseudoalbuminuria

(*Pagina 954*)

Es commun le occurrentia de pseudoalbuminuria post cholecystographia oral. In 25 patientes, tests pro albuminuria esseva negative ante le administration de Orabilex e positive dece-cinque horas post le ingestion del medio in un dose de 4,5 grammas, con reagente de Roberts o con 3 pro cento de acido sulfasalicylic. Tamen, solmente 1 test de calor e acido acetic esseva positive.

Viste que Orabilex per se rende un altemente positive test pro albumine e viste que illo es eliminate primarimente via le systema urinari, un test a positivitate pro albumina non indica morbo o vitiation renal. Le uso del test de calor e acido acetic plus tosto que reagente de Roberts o 3 pro cento de acido sulfasalicylic pro albuminuria evita usualmente iste falsemente positive reaction.

EDITORIAL

What the Mirror Sees

Most radiologists in the United States are aware of the magnificent job which the American College of Radiology is doing in the field of public relations. This is due to the hard work of many dedicated individuals, including officers, commission members, and executive staff of the College. In addition to this organized activity at the top, however, it has been pointed out repeatedly that every single member of the College has the responsibility and privilege of carrying on this program of good public relations, constantly in his daily practice.

In the conduct of his personal and professional life, each radiologist influences the opinions of two groups: the public and other doctors. The public relations requirements for these two groups differ. One should, of course, be a gentleman and live by Christian standards. But it does no good to be a "doctors' doctor" if patients don't like you; and the best "bedside manner" will not help if the referring physicians distrust your skill and judgment.

One portion of our public relations problem was presented in a fascinating way at the meeting of the American College of Radiology in New Orleans in February 1960. The speaker, following the annual Teachers' Conference luncheon, was John S. DeTar, M.D., of Milan, Michigan. He is a Past President (and one of the organizers) of the American Academy of General Practice, Past President of the Michigan Health Council, board member of the Michigan Medical Service (Blue Shield), and delegate to the House of Delegates of the American Medical Association. He is a fluent, dynamic speaker with a sense of humor. His topic was "What the Generalist Thinks of the Radiologist."

Dr. DeTar's remarks were based on answers to a questionnaire which he sent to fifty eminent physicians in general practice, one in each of our fifty states. The entire paper has been published by the College in its *Proceedings of the Annual Conference of Teachers of Radiology* (Am. Coll. Radiol. Bull. **16:** 1-4, October 1960) and should be read carefully by every practicing radiologist. However, some of his conclusions can be considered here.

The fifty general practitioners responding to the questionnaire feel that the great majority of radiologists with whom they come in contact merit great respect from referring physicians, particularly because of professional competence. The "generalists" believe that "their" radiologists are sympathetic with the problems of the family doctor and act in the capacity of true consultants.

These same family doctors, however, think that many radiologists are not sufficiently concerned with patients as people; and that a greater measure of human interest would rectify some of the radiologist's shortcomings in dealing with the public. The "generalists" suggest that teachers of radiology, by emphasis on the human and personal interest aspects of medical care, could alter to a large degree the attitude of practicing radiologists in a constructive manner.

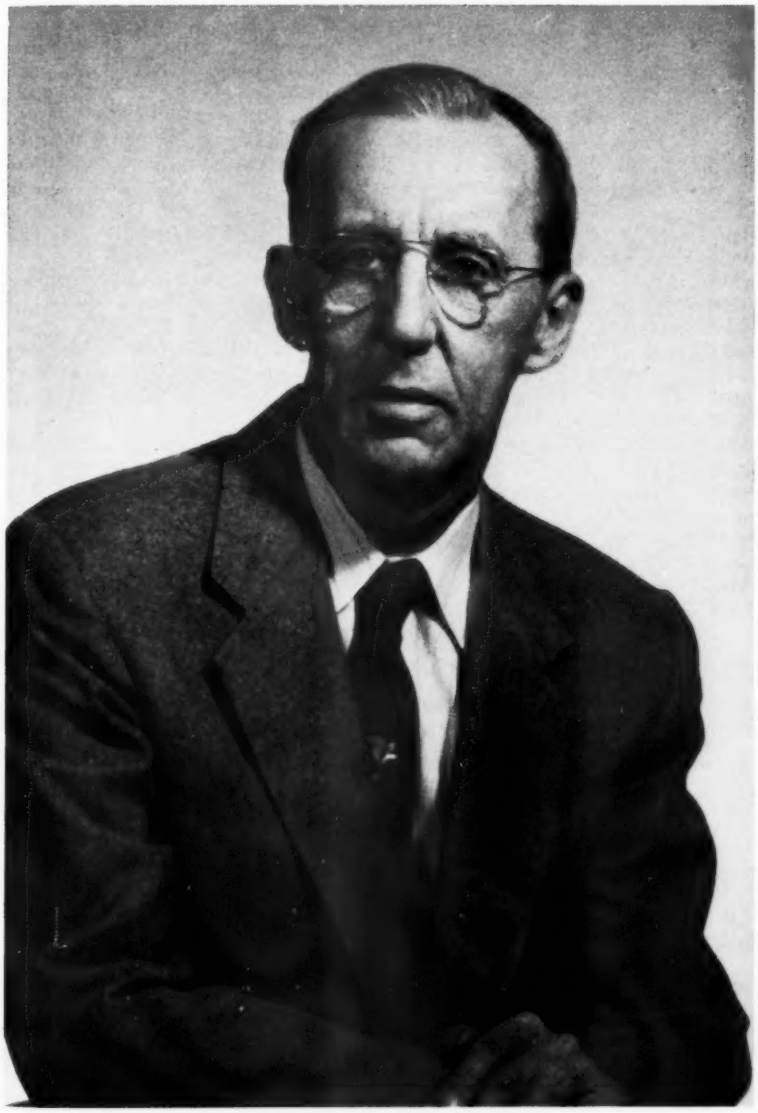
Lastly, many general practitioners feel that there are local problems and irritations involving professional ethics, quality of radiological care, and medical economics which could and should be solved by the conference method on the local level. For example, in certain sections of the country, the question of a radiologist routinely read-

ing films made by someone else is a sticky problem. Some general practitioners think this is in the patient's interest; most radiologists do not.

Wisdom demands that we consider these evaluations by our peers. Good or bad, just or unjust, they show us how we look to other people. The minus side of the ledger deals with impersonal attitudes, an old complaint about radiologists. Maybe an experience with personal illness is needed to make each of us more compassionate. Lacking this, we must try consciously and continuously to put ourselves in the patient's place.

ROBERT P. BARDEN, M.D.

IN MEMORIAM



THEODORE P. EBERHARD, M.D.

1904–1960

"When I consider life and its few years,
A wisp of fog betwixt us and the sun,
A call to battle, and the battle done
Ere the last echo dies within our ears. . . ."

Lizette W. Reese

On the morning of August 14th, 1960, the Eberhard family were awakened at six A.M. by the barking of their dog. They were spending their vacation at their cottage on an island in Georgian Bay, Ontario, Canada. Ted was to have arisen at four to meet his daughter, coming up by train. It was found that he had died in his sleep, at the age of fifty-six years; he had not been ill.

Ted Eberhard was born in Akron, Ohio, in 1904. After graduating from Akron University, he went

to Western Reserve School of Medicine and received his M.D. in 1930. Then began nine years of postgraduate training; as an intern at Lakeside Hospital, Cleveland, 1931–1932, and New England Deaconess Hospital, Boston, 1932–1933; as resident pathologist with the Pondville State Cancer Hospital in Wrentham, Mass., 1933–1934; as a Fellow in Surgery at the Presbyterian Hospital in New York City, 1934–1936; and as Instructor in Pathology, 1936–1937, and Instructor in Radiology, 1937–1939, at the College of Physicians and Surgeons, Columbia University.

From 1939 to 1942 Dr. Eberhard was Medical Director of the Ellis Fischel State Cancer Hospital in Columbia, Mo. He left to join the Medical Corps of the United States Army soon after we entered the Second World War and was on active duty with the Eighth General Hospital, serving with this unit in New Caledonia. After returning to civilian life in 1946, he became Radiation Therapist to the Jefferson Medical College Hospital in Philadelphia. He also held the appointment of Clinical Professor of Radiology in the Jefferson Medical School.

The next nine years were happy and productive in Ted's life, and many were the friends and grateful patients whom he left behind, when he resigned his post at Jefferson in 1955. In that year, he moved to Ann Arbor, Michigan, to become Therapist in the Department of Radiology at the St. Joseph's Mercy Hospital where he remained until his death.

Ted loved his home, as he did his work. In 1933 he married Mary Jane Nickles in Brattleboro, Vermont. Their children, Richard Allen, Elizabeth Ann, and Nancy Jean are a splendid tribute to this union.

In medical affairs, Ted's counsel and sound judgment were sought frequently. He was active in his local and state medical societies both in Philadelphia and later in Ann Arbor. He was President of the Philadelphia Roentgen Ray Society in 1952–1953. He was a Fellow of the American College of Radiology and Chairman of its Subcommittee on Cancer; he represented the College on the Committee on Cancer of the American College of Surgeons and was a member of the Joint Committee (Radiology and Surgery) on Clinical Cancer Staging and End Result Reporting. He was Chairman of the Committee on Radiologic Units, Standards, and Protection of the College.

Dr. Eberhard was an active member of the Radiological Society of North America, the American Roentgen Ray Society, and the American Radium Society. At the time of his death, he was Chairman of the Liaison Committee between the Detroit X-ray and Radium Society and the Michigan Blue Cross-Blue Shield Plans.

So much for the reporting of accomplishments of a busy and productive professional life. His friends were proud of Ted for what he did, but loved him for what he was. We shall remember him for his soft, measured, drawling speech, thoughtful, gently humorous, occasionally sardonic. We shall remember him as a gentleman, courteous, and deeply sympathetic for his fellow man. We shall remember him because of his poise and innate integrity, which made him so easy to talk to and so helpful in solving the problems of others.

Thoughtful scholar, compassionate physician, steadfast friend, we shall remember him.

ROBERT P. BARDEN, M.D.

ALFRED A. deLORIMIER, M.D.

The following account of Dr. Alfred A. deLorimier who died July 19, 1960, is reprinted, by permission, from the San Francisco Medical Society *Bulletin*.

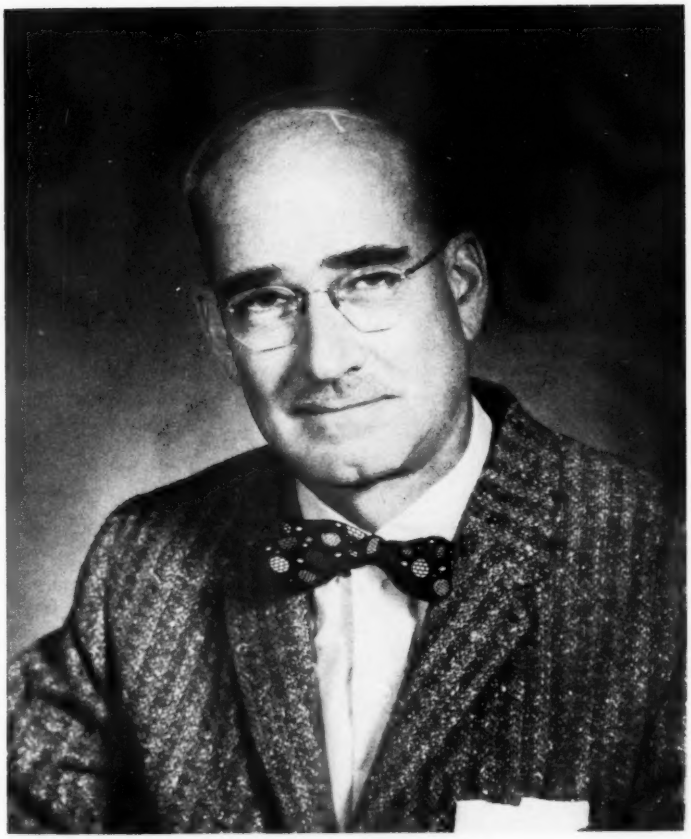
The recent death of Alfred A. deLorimier deprived San Francisco of an outstanding radiologist whose professional attainments were recognized at home and abroad.

Born in Fort Benton, Mont., where he received his early education, he moved to Berkeley with his family in 1919. He attended the University of California where he received his A.B. degree in 1923, his Master's degree in 1925, and his M.D. in 1927.

Doctor deLorimier interned at the Letterman General Hospital and subsequently received his training in radiology at the University of Pennsylvania while in the U. S. Army. He was sent as radiologist to the Gorgas Hospital in the Canal Zone and occupied this post for four years. He was recalled to the Army Medical Center to undertake a research program and to teach radiology.

Doctor deLorimier was appointed commandant of the Army School of Roentgenology in Memphis, Tenn., and held this position during 1944 and 1945. He was responsible for designing the U. S. Army Field X-ray unit and also the foreign body localizer which were used in combat areas during World War II. The U. S. Army awarded Doctor deLorimier the Legion of Merit, the Army Commendation Ribbon, and the Atomic Campaign Medal in recognition of his professional accomplishments. In 1945, he was sent by the Army to Hiroshima, Nagasaki, and later to Bikini to study radiation effects.

Doctor deLorimier retired from the U. S. Army in 1946 and returned to San Francisco, where he engaged in the practice of radiology until his death. He made many significant contributions in the field of radiology which were published in the current medical literature. He was also the author of a handbook entitled "*The Arthropathies*" and a four-volume set entitled "*Clinical Roentgenology*."



ALFRED A. deLORIMIER, M.D.
1901–1960

Doctor deLorimier was a member of the San Francisco Medical Society, American Roentgen Ray Society, Radiological Society of North America, San Francisco Radiological Society, Pacific Roentgen Society, Fellow of the American College of Chest Surgeons, American College of Radiology, the Olympic Club, and Alpha Kappa Kappa.

Those who were privileged to know and work with him for years held him in high esteem for his professional skill. However, he enjoyed the deep affection of his friends, colleagues, and patients because of his personal attributes. His endless patience coupled with a broad understanding of pathology made him an unusually valuable consultant.

Doctor deLorimier did not have the opportunity to achieve distinction on the field of combat but the courage which he demonstrated during his last illness provoked the profound admiration of all of his colleagues.

He is survived by his widow, Emilie B. deLorimier, and by a daughter, Jeannette Anne deLorimier, and three sons, Alfred A. deLorimier, Jr., M.D., Jacques A. deLorimier, D.D.S., and Charles deLorimier.

FRANCIS ROCHEX, M.D.

EUGENE H. DOBLE, M.D.

Dr. Eugene Doble of Presque Isle, Me., died on June 29, 1960, after sixty years in the practice of medicine and fifty-two years as a radiologist. He was a pioneer in roentgen therapy and is said to have been one of three physicians introducing the therapeutic use of x-rays into New England in 1903. Operative scars on his hands bore testimony to injuries incurred in these early days.

EUGENE H. DOBLE, M.D.
1876–1960

Dr. Doble was born in Livermore Falls, Me., Sept. 19, 1876, the son of Ronella L. and Lillian Howard Doble. He was graduated from Baltimore Medical College in 1900 and spent the remainder of his life in practice in Presque Isle. He was a fellow of the American College of Radiology and a member of the Radiological Society of North America. He was a Past President of the Presque Isle Rotary Club and was instrumental in the establishment of that city's first airport.

Dr. Doble is survived by his widow, Edna Purvis Doble, and a son, Dr. Howard R. Doble of Baltimore.

ANNOUNCEMENTS AND BOOK REVIEWS

AMERICAN BOARD OF RADIOLOGY

The Spring 1961 examination by the American Board of Radiology will be held at the Denver Hilton Hotel, Denver, Colo., June 19–22, inclusive. The deadline for filing applications is Jan. 1, 1961. There will be no special examination in Nuclear Medicine.

The Fall 1961 examination will be held at the Shoreham Hotel, Washington, D. C., Dec. 4–7, inclusive. The deadline for filing applications is July 1, 1961. A special examination in Nuclear Medicine will be offered if there are sufficient applications. H. DABNEY KERR, M.D., *Secretary*

AMERICAN ROENTGEN RAY SOCIETY

At the sixty-first annual meeting of the American Roentgen Ray Society in Atlantic City, Sept. 27–30, Harold G. Reinicke, M.D., Cincinnati, Ohio, assumed the presidency. Other officers were elected as follows: Traian Leucutia, M.D., Detroit, Mich., President-Elect; Clyde A. Stevenson, M.D., Spokane, Wash., First Vice-President; Samuel W. Donaldson, M.D., Ann Arbor, Mich., Second Vice-President; C. Allen Good, M.D., Rochester, Minn., Secretary; Stephen W. Brown, M.D., Augusta, Ga., Treasurer; Ralph M. Caulk, M.D., Washington, D.C., Chairman of the Executive Council.

The Annual Caldwell Lecture was delivered by the President-Elect, Traian Leucutia, M.D.

A group of nine Detroit physicians, all members of the teaching staff of Wayne State University Medical College, was the recipient of the scientific exhibit Gold Medal, the first to be awarded since 1952. Dr. L. M. Thomas represented the group in accepting the Medal. Other members were E. S. Gurdjian, M.D., James E. Lofstrom, M.D., D. W. Lindner, M.D., W. G. Hardy, M.D., S. J. Figiel, M.D., Maurice Croll, M.D., J. E. Webster, M.D., and J. L. Whelan, M.D.

The Sixty-Second Annual Meeting of the Society will be held at Miami Beach, Sept. 26–29, 1961.

RADIOLOGICAL SOCIETY OF GREATER CINCINNATI

The Radiological Society of Greater Cincinnati has recently installed Carl W. Koehler, M.D., Cincinnati, as President. Other officers are Stanley Lucas, M.D., Cincinnati, Vice-President, and W. Donald Janny, M.D., 722 Scott St., Covington, Ky., Secretary-Treasurer.

CLEVELAND RADIOLOGICAL SOCIETY

At a recent meeting of the Cleveland Radiological Society the following officers were elected: President, Frederick A. Rose, M.D., Cleveland; Vice-President, Norman Glazer, M.D., Akron; Secretary-Treasurer, Norman E. Berman, M.D., 14404 S. Park Blvd., Shaker Heights 20; Member-at-Large, Robert D. Berkebile, M.D., Elyria.

EASTERN CONFERENCE OF RADIOLOGY

The annual meeting of the Eastern Conference of Radiology will be held March 9–11, 1961, at the Lord Baltimore Hotel, Baltimore, Md. The host society for this meeting will be the Maryland Radiological Society, and communications may be addressed to Philip Myers, M.D., Baltimore City Hospital, Baltimore 24, Md.

FLORIDA WEST COAST RADIOLOGICAL SOCIETY

At the October meeting of the Florida West Coast Radiological Society the following were elected for the coming year: President, James T. Shelden, M.D., Lakeland; Vice-President, Richard V. Meaney, M.D., Bradenton; Secretary-Treasurer, Joseph C. Rush, M.D., 1800 Druid Road, Clearwater.

LOS ANGELES RADIOLOGICAL SOCIETY MIDWINTER CONFERENCE

The Thirteenth Annual Midwinter Radiological Conference, sponsored by the Los Angeles Radiological Society, will be held at the Biltmore Hotel, Los Angeles, Calif., on Saturday and Sunday, Jan. 28–29, 1961.

An outstanding program has been arranged. Guest speakers will be Dr. James W. D. Bull, London, England; Dr. John Boland, New York, N. Y.; Dr. John A. Kirkpatrick, Philadelphia, Penna.; Dr. John F. Holt, Ann Arbor, Mich.

The Conference fee of $20.00 includes two luncheon meetings featuring questions and answers. A banquet ($7.50 per plate) preceded by cocktails will be held Saturday evening. Reservations may be made through Joseph Parks, M.D., 14500 Sherman Circle, Van Nuys, Calif.

Courtesy cards will be available to residents in Radiology and to radiologists in the Armed Forces by advance registration, with reduced tariff for the luncheons and banquet. Hotel reservations should be made promptly through the Convention Manager, Biltmore Hotel, Los Angeles, Calif.

NORTH CAROLINA RADIOLOGICAL SOCIETY

Recently elected officers of the North Carolina Radiological Society are: I. Meschan M.D.,

Winston-Salem, President; Owen W. Doyle, M.D., Greensboro, President-Elect; S. I. Patrick, M.D., Kinston, Vice-President; A. Bascom Croom, M.D., 1102 Greenway Drive, High Point, Secretary-Treasurer.

EAST TENNESSEE RADIOLOGICAL SOCIETY

The East Tennessee Radiological Society, at its annual meeting in Gatlinburg, elected to office John M. Higgason, M.D., Chattanooga, President; Clifford L. Walton, Jr., M.D., Knoxville, Vice-President; James Jacob Range, M.D., Johnson City, President-Elect; J. Marsh Frere, Jr., M.D., 205 Medical Arts Bldg., Knoxville, Secretary-Treasurer.

WISCONSIN RADIOLOGICAL SOCIETY

Newly elected officers of the Wisconsin Radiological Society are: President, Farrell F. Golden, M.D., Madison; President-Elect, John H. Juhl, M.D., Madison; Secretary-Treasurer, Howard G. Bayley, Jr., M.D., 116 Iroquois Parkway, Beaver Dam; Councilor to the American College of Radiology, Irving I. Cowan, M.D., Milwaukee; Alternate Councilor, Ralph C. Frank, M.D., Eau Claire.

SOCIETY FOR PEDIATRIC RADIOLOGY

At the Annual Meeting of the Society for Pediatric Radiology in Atlantic City, N.J., John F. Holt, M.D., University Hospital, Ann Arbor, Mich., was installed as President for the year 1960–1961. Arthur S. Tucker, M.D., University Hospitals, Cleveland, Ohio, was named President-Elect, and Richard G. Lester, M.D., University of Minnesota Hospitals, 412 Union St., S.E., Minneapolis 14, was re-elected Secretary-Treasurer.

The next annual meeting of the Society will be held Sept. 25, 1961, in Miami Beach, Fla.

SECOND INTERNATIONAL CONGRESS OF RADIATION RESEARCH

The Second International Congress of Radiation Research will be held at Harrogate, Yorkshire, England, Aug. 5–11, 1962, under the sponsorship of a Committee set up at the First Congress, held in Burlington, Vt., in 1958, and by the Association for Radiation Research. The program will be concerned with the physical, chemical, biological, and medical effects of radiations, particularly of ionizing radiations. Research workers in these fields are invited to proffer original papers and reports of new experimental work.

A brochure will be available for distribution in April 1961. Meanwhile further information may be obtained from Dr. Alma Howard, Secretary-General, Mount Vernon Hospital, Northwood, Middlesex, England.

COURSE IN CLINICAL USE OF RADIOACTIVE ISOTOPES

A course in the clinical use of radioactive isotopes will be given under the supervision of Dr. Sergei Feitelberg and Dr. Edith Quimby of the Department of Radiology, Columbia University, New York, N. Y., from June 5 through June 30, 1961. This is a full-time course which includes lectures, experimental laboratory exercises, clinical rounds, and clinical measurements on patients and on specimens. In addition to Dr. Feitelberg and Dr. Quimby, the teaching staff includes sixteen invited lecturers from the New York area, each presenting material in his own special field.

Lectures: Topics include physics of radioactive isotopes, interaction of radiation and matter, and technics of measurement of radiation and of radioactive isotopes. Clinical uses of radioactive iodine, phosphorus, and gold will be presented in detail; special lectures will cover miscellaneous diagnostic studies with radioactive iron, sodium, chromium, and other elements. Organization of isotope work in a hospital will be developed from a practical point of view.

Laboratory Work: Thirteen afternoons are devoted to experiments on basic methods of radioisotope measurements, technics used in clinical studies, and experience with actual clinical procedures.

Enrollment in the class is limited to 20; the fee is $300.

Inquiries should be addressed to Dr. Sergei Feitelberg, Mt. Sinai Hospital, Fifth Avenue at 100th Street, New York 29, N. Y.

ISOTOPES COURSE QUEENS HOSPITAL CENTER, NEW YORK

A four-month course in the Medical Uses of Radioactive Isotopes is being offered at the Queens Hospital Center by the Radiation Medicine Department, beginning Feb. 7, 1961. Weekly five-hour sessions will include lectures, laboratory exercises, and the clinical management of patients. The tuition is $275.00.

Requests for further information should be sent to Dr. Philip J. Kahan, Supervising Medical Superintendent, Queens Hospital Center, 82-68 164th Street, Jamaica 32, N. Y.

RADIOLOGY AND RADIOACTIVE ISOTOPES POSTGRADUATE COURSE

The University of Kansas has announced a three-day postgraduate course in Radiology and Radioactive Isotopes to be conducted at its Medical Center, Feb. 20–22, 1961. There will be a guest faculty of eight nationally recognized authorities. Two days will be given to diagnosis and therapy and the discussions of the third day will concern radioactive isotopes. This final program will be of interest to the internist as well as to the radiologist.

Further information about the program and registration may be obtained from the University of Kansas School of Medicine, Department of Postgraduate Medical Education, Kansas City 12, Kans.

TRAINING PROGRAM IN RADIATION BIOLOGY AND CANCER-RELATED RESEARCH

The Bowman Gray School of Medicine announces the institution of a training program in Radiation Biology and Cancer-Related Research. One-, two-, and three-year traineeships are being offered at both predoctoral and postdoctoral levels. Inquiries may be directed to Donald J. Pizzarello, Ph.D., Executive Director, Radiation Biology and Cancer-Related Research Training Program, Bowman Gray School of Medicine, Winston-Salem, N. C.

DIAGNOSTIC RADIOLOGY COURSE UNIVERSITY OF CALIFORNIA

The University of California Medical Center in San Francisco is planning a one-week course in Diagnostic Radiology for March 15–20, 1961. The course is designed primarily for practicing radiologists and will include lectures, panel discussions, and demonstrations. The Faculty of the University of California School of Medicine will be augmented by visiting lecturers from throughout the country.

Further information may be obtained from the Department of Continuing Education in Medicine and Health Sciences, University of California Medical Center, San Francisco 22, Calif.

UNIVERSITY OF CINCINNATI FELLOWSHIPS

The Department of Radiology of the University of Cincinnati College of Medicine and the Cincinnati General Hospital are offering two fellowships: One in the field of radiobiology, radioisotopes, and radiological research technics, is offered to physicians who have completed their formal residency training. It is not restricted to radiologists. The second fellowship is open to physicians who have completed internship or some part of their residency training and is designed to acquaint the Fellow with research methods which employ radioisotopes and other radiation sources. Appointments will be made for the year beginning July 1, 1961. Interested physicians should communicate with the Department of Radiology, University of Cincinnati College of Medicine, General Hospital, Cincinnati 29, Ohio.

DR. W. EDWARD CHAMBERLAIN HONORED

On Oct. 19, 1960, Dr. W. Edward Chamberlain was awarded the Edward Longstreth Medal of the Franklin Institute, Philadelphia, for his contributions to radiological engineering. The citation reads:

"For his continuous and effective analyses and applications of physics and engineering to the techniques of radiology; for his keen insight into all of the diverse phenomena contributing to the fluoroscopic process; and for his stimulation of the development of new devices."

Dr. Chamberlain was Professor of Radiology at Temple University Medical School and Director of the Department of Radiology at Temple University Hospital from 1930 until his retirement in 1957, when he joined the Veterans Administration, Washington, D. C. There he is Special Assistant to the Chief Medical Director for Atomic Medicine. He was the Carman Lecturer of the Radiological Society of North America in 1941 and was awarded its Gold Medal in 1948.

DR. PAUL C. HODGES, LECTURER

Dr. Paul C. Hodges, Professor Emeritus of Radiology of the University of Chicago, Chicago, Ill., lectured on *Medicine in Russia and in Free China*, Oct. 18, 1960, at the Fifth Series of Lectures on the History of Surgery and Related Sciences at the International College of Surgeons' Hall of Fame.

Letter to the Editor

To the Editor of Radiology

DEAR DR. DOUB:

To facilitate quick finding of films in the darkroom for preliminary wet reading I have designed a plastic clip which snaps easily onto the film hanger. The clip, which is designed somewhat like a clothespin, is inert to x-ray solutions and comes in sets of ten colors which may be assigned to the films of any particular patient or physician. The clips have been in use in the X-ray Department of Welborn Baptist Hospital in Evansville for about two years and have proved to be very useful and time-saving. They are distributed in a plastic wall-dispenser by McMasters, Inc., 1800 Park Street, Evansville, Ind.

Your readers may be interested in knowing of them.

ALFRED J. NIEDERMAYER, M.D.
Evansville, Ind.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

THE NORMAL SKULL: A ROENTGEN STUDY. By ROBERT SHAPIRO, M.D., Chairman, Department of Radiology, The Hospital of Saint Raphael, New Haven; Associate Clinical Professor of

Radiology, Yale University School of Medicine; and ARNOLD H. JANZEN, M.D., Assistant Radiologist, The Hartford Hospital, Hartford; Former Chairman, Department of Radiology, The Grace-New Haven Community Hospital and Yale University School of Medicine, New Haven. A volume of 258 pages, with 645 illustrations on 277 figures. Published by Paul B. Hoeber, Inc., Medical Division of Harper & Brothers, New York 16, N. Y., 1960. Price $18.00.

FUNDAMENTALS OF CHEST ROENTGENOLOGY. By BENJAMIN FELSON, M.D., Professor and Director, Department of Radiology, University of Cincinnati College of Medicine; Director, Departments of Radiology, Cincinnati General, Children's, Daniel Drake, Dunham, Christian R. Holmes, and Longview Hospitals; Special Consultant, U.S. Public Health Service; Consultant to the Dayton and Cincinnati Veterans Administration Hospitals. A volume of 302 pages, with 450 illustrations on 238 figures. Published by W. B. Saunders Co., Philadelphia, Penna., 1960. Price $10.00.

RADIATION THERAPY OF EARLY PROSTATIC CANCER. By R. H. FLOCKS, M.D., and D. A. CULP, M.D., State University of Iowa, Department of Urology, Iowa City, Iowa. Publication Number 399, American Lecture Series. A monograph of 74 pages, with 40 figures. Published by Charles C Thomas, Springfield, Ill., 1960. Price $4.50.

THE DELAYED EFFECTS OF WHOLE-BODY RADIATION: A SYMPOSIUM. Edited by BERNARD B. WATSON. Jointly sponsored by the Operations Research Office and the Walter Reed Army Institute of Research. A monograph of 80 pages, with figures and tables. Published for Operations Research Office, The Johns Hopkins University, by The Johns Hopkins Press, Baltimore 18, Md., 1960. Price $4.50.

TUMORS OF THE ODONTOGENIC APPARATUS AND JAWS. By JOSEPH L. BERNIER, D.D.S., M.S., F.D.S., R.C.S., England; Major General, Dental Corps, U.S. Army; Assistant Surgeon General, Chief of Dental Corps, U. S. Army; Former Chief, Oral Pathology Division, Armed Forces Institute of Pathology; Professor and Chairman of the Department of Oral Pathology, Georgetown University School of Dentistry, Washington, D.C. Atlas of Tumor Pathology, Section IV, Fascicle 10a. A monograph of 110 pages, with 120 figures and 2 color plates. Published by the Armed Forces Institute of Pathology Under the Auspices of the Subcommittee on Oncology of the Committee on Pathology of the Division of Medical Sciences of the National Academy of Sciences—National Research Council, Washington, D.C., 1960. For sale by the American Registry of Pathology, Armed Forces Institute of Pathology, Washington 25, D.C. Price $1.00.

ARTEFACTS AND HANDLING AND PROCESSING FAULTS ON X-RAY FILMS. By Prof. Dr. E. A. ZIMMER, Berne, Switzerland. Translated from "Filmfehler in der Röntgenpraxis" (published by Georg Thieme, Stuttgart, Germany, 1960) by Dr. E. W. Loos. A monograph of 68 pages, with 128 figures. Published by Grune & Stratton, Inc., New York 16, N. Y., 1960. Price $5.75.

MEDICAL ELECTRONICS: PROCEEDINGS OF THE SECOND INTERNATIONAL CONFERENCE ON MEDICAL ELECTRONICS, PARIS, 24–27 JUNE 1959. Edited by C. N. SMYTH, M.A., B.Sc.(Eng.), B.M., B.Ch., M.I.E.E. A volume of 614 pages, with numerous figures. Published by Iliffe & Sons Ltd., London, England; Charles C Thomas, Springfield, Ill., 1960. Price $29.50.

USE OF RADIOISOTOPES AND SUPERVOLTAGE RADIATION IN RADIOTELETHERAPY: PRESENT STATUS AND RECOMMENDATIONS. Report of and Background Information for a Study Group Convened by the IAEA and WHO. A monograph of 88 pages, with 9 tables. Published by International Atomic Energy Agency, Kärntner Ring, Vienna I, Austria, 1960. Price $1.50. Sole distributor in North America, International Publications, Inc., 801 Third Ave., New York 22, N. Y.

LARGE RADIATION SOURCES IN INDUSTRY. I. PROCEEDINGS OF A CONFERENCE ON THE APPLICATION OF LARGE RADIATION SOURCES IN INDUSTRY AND ESPECIALLY TO CHEMICAL PROCESSES ORGANIZED BY THE INTERNATIONAL ATOMIC ENERGY AGENCY, WARSAW, 8–12 SEPTEMBER 1959. A volume of 478 pages, with figures and tables. Published by International Atomic Energy Agency, Kärntner Ring, Vienna I, Austria, 1960. Price $4.50. Sole distributor in North America, International Publications, Inc., 801 Third Ave., New York 22, N. Y.

JENS NIELSEN ANNO AETATIS SUAE LX. PAPERS DEDICATED TO JENS NIELSEN, PROFESSOR OF RADIOTHERAPY AT THE UNIVERSITY OF COPENHAGEN ON HIS SIXTIETH ANNIVERSARY, DECEMBER 19, 1959. Edited by SIGVAARD KAAE, JOHAN AMBROSEN, HARALD CHRISTIANSEN, SVEN HULTBERG, and GREGERS THOMSEN. Acta radiol. Suppl. 188, 284 pages, with 135 figures and 61 tables. Published by Acta radiol., Stockholm 2, Sweden, 1959. Price Sw. Kr. 40:—

ATTAINMENT AND VALUE OF PRECISION IN DEEP RADIOTHERAPY: SOME FUNDAMENTALS WITH SPECIAL REFERENCE TO MOVING BEAM THERAPY

WITH 200 TO 250 KV ROENTGEN RAYS AND COBALT 60 GAMMA RADIATION. By OLOV DAHL and KARL JOHAN VIKTERLÖF. From Radiumhemmet and the Institute of Radiophysics, Karolinska Sjukhuset, Stockholm 60, Sweden. Acta radiol. Suppl. 189. A monograph of 224 pages, with 90 figures and 25 tables. Published by Acta radiol., Stockholm 2, Sweden, 1960. Price Sw. Kr. 35:—

DISTRIBUTION AND KINETICS OF BROMIDE IONS IN THE MAMMALIAN BODY: SOME EXPERIMENTAL INVESTIGATIONS USING Br^{80m} AND Br^{82}. By RUNE SÖREMARK. From the Department of Prosthetics and the Clinical Laboratory at the Royal School of Dentistry, the Isotope Laboratory of the Department of Obstetrics and Gynecology at Sabbatsberg Hospital, Karolinska Institutet, and the Department of Pharmacology at the Royal Veterinary College, Stockholm, Sweden. Acta radiol. Suppl. 190. A monograph of 114 pages, with 31 figures and 17 tables. Published by Acta radiol., Stockholm 2, Sweden, 1960. Price Sw. Kr. 30:—

RADIOLOGIC PELVIMETRY. By ULF BORELL and INGMAR FERNSTRÖM. From the Department of Women's Diseases, and the Department of Diagnostic Roentgenology, Karolinska Sjukhuset, Stockholm, Sweden. Acta radiol. Suppl. 191. A monograph of 98 pages, with 49 figures and 10 tables. Published by Acta radiol., Stockholm 2, Sweden, 1960. Price Sw. Kr. 30:—

RENAL PAPILLARY NECROSIS: A ROENTGENOGRAPHIC STUDY OF 155 CASES. By NILS LINDVALL. From the Roentgen Diagnostic Department, Karolinska Sjukhuset, Stockholm, Sweden. Acta radiol. Suppl. 192. A monograph of 154 pages, with 58 figures and 7 tables. Published by Acta radiol., Stockholm 2, Sweden, 1960. Price Sw. Kr. 30:—

THE TOMOGRAM: ITS FORMATION AND CONTENT. By PAUL EDHOLM. From the Central Department of Radiologic Diagnosis, Karolinska Sjukhuset, Stockholm, Sweden. Acta radiol. Suppl. 193. A monograph of 110 pages, with 74 figures and 1 table. Published by Acta radiol., Stockholm 2, Sweden, 1960. Price Sw. Kr. 30:—

PLEURAL CALCIFICATION AS A ROENTGENOLOGIC SIGN OF NON-OCCUPATIONAL ENDEMIC ANTHOPHYLLITE-ASBESTOSIS. By RAIMO KIVILUOTO. MINERALOGICAL APPENDIX. By OLAVI KOUVO. From the Roentgen Department of the Central Hospital of Northern Karelia and the Roentgenologic Department of Turku University. Turku, Finland. Acta radiol. Suppl. 194. A monograph of 68 pages, with 25 figures and 12 tables. Published by Acta radiol., Stockholm 2, Sweden, 1960. Price Sw. Kr. 25:—

ROENTGENOGRAPHIC STUDIES ON EPIPHYSIAL GROWTH AND OSSIFICATION IN THE KNEE. By SVEN SCHELLER. From the Roentgen Diagnostic Department and the Institute of Anatomy, University of Gothenburg, Sweden. Acta radiol. Suppl. 195. A monograph of 304 pages, with 177 figures and 57 tables. Published by Acta radiol., Stockholm 2, Sweden, 1960. Price Sw. Kr. 35:—

BIOENERGETICS: CONSIDERATIONS OF PROCESSES OF ABSORPTION, STABILIZATION, TRANSFER, AND UTILIZATION. PROCEEDINGS OF A SYMPOSIUM SPONSORED BY THE U. S. ATOMIC ENERGY COMMISSION HELD AT BROOKHAVEN NATIONAL LABORATORY, OCTOBER 12–16, 1959. Edited by LEROY G. AUGENSTINE. Suppl. 2, 1960, Radiation Research. Published by Academic Press, New York 3, N. Y., 1960. Price $10.00.

DIE OKZIPITALE DYSPLASIE. By Doz. Dr. HERMANN SCHMIDT and Dr. ERICH FISCHER, Med.-Strahleninstitut der Universität Tübingen. Heft 9, Zwanglose Abhandlungen aus dem Gebiet der normalen und pathologischen Anatomie, edited by Prof. Dr. W. Bargmann, Direktor des Anatomischen Instituts der Universität Kiel and Prof. Dr. W. Doerr, Direktor des Pathologischen Instituts der Universität Kiel. A monograph of 70 pages with 108 illustrations on 69 figures. Published by Georg Thieme, Herdweg 63, (14a) Stuttgart, Germany, 1960. Price DM 35.— ($8.75); to subscribers to the series DM 28.— ($6.70). Distributed in the United States and Canada by the Intercontinental Medical Book Corporation, New York 16, N. Y.

Book Reviews

NEOPLASMS OF BONE AND RELATED CONDITIONS: ETIOLOGY, PATHOGENESIS, DIAGNOSIS, AND TREATMENT. By BRADLEY L. COLEY, M.D., Attending Surgeon (Emeritus), Bone Tumor Department, Memorial Hospital for Cancer and Allied Diseases, New York. A volume of 864 pages, with 649 illustrations and 31 tables. Published by Paul B. Hoeber, Inc., Medical Division of Harper & Brothers, New York 16, N. Y., 2d ed., 1960. Price $30.00.

In his work on Neoplasms of Bone, published originally in 1949, Dr. Coley supplied a long felt need of radiologists and others concerned with these lesions. Those whose libraries do not contain a copy of this book will warmly welcome the Second Edition now appearing, while former readers will find in it a renewal of their interest.

The scope of the work is indicated in the original

review appearing in RADIOLOGY (**52**: 735, 1949). Though a large part has been revised and some portions have been rewritten, the same general plan is followed, with emphasis on early diagnosis, clinical aspects, therapeutic indications and technics, and prognosis rather than on microscopic anatomy.

Several new entities, such as chondromyxoid fibroma, aneurysmal bone cyst, juxtacortical low grade osteosarcoma, and malignant angioblastoma, are described. The serious implications of tumors derived from cartilage and the importance of secondary chondrosarcoma are considered.

Considerable emphasis is placed on radiation therapy and five chapters by Dr. Ralph Phillips of Memorial Hospital are devoted to the indications for and the effects of irradiation. Constitutional therapy of various types is also discussed.

The text is illustrated by more than 400 well chosen radiographs, photographs, and sketches. Numerous tables are also included. An excellent bibliography follows each section. A comprehensive index completes the volume.

This book should be of great value to radiologists on whom the burden of the initial and often the final diagnosis of bone tumors is placed. It will also be widely used by surgeons and students of skeletal disease.

INDUSTRIAL PULMONARY DISEASES: A SYMPOSIUM HELD AT THE POSTGRADUATE MEDICAL SCHOOL OF LONDON, 18TH-20TH SEPTEMBER, 1957, AND 25TH-27TH MARCH, 1958. Edited by E. J. KING, M.A., D.Sc., F.R.I.C., Postgraduate Medical School of London, and C. M. FLETCHER, C.B.E., M.D.(Cantab.), F.R.C.P., Postgraduate Medical School of London. A volume of 274 pages, with 98 illustrations. Published by Little, Brown & Co., Boston 6, Mass., 1960. Price $8.50.

This timely volume on pneumoconiosis contains an integrated account of a Symposium held at the Postgraduate Medical School of London in September 1957 and March 1958. The authors of the various chapters are authorities in their fields and the pneumoconioses are covered in all aspects, from the physics and biology of dust, through experimental, pathological, physiological, and epidemiological studies, to radiological and clinical investigations and treatment of the patient.

Industrial pulmonary disease long has been a subject of intensive investigation in the British Empire. Industrial hazards are constantly changing with new industrial methods. Some concepts of pneumoconiosis are being re-evaluated, re-studied, and re-tested. All of these various phases are considered in this magnificent volume. It will serve a most useful purpose for anyone interested in dust hazards. The chapters are beautifully arranged, thereby widening the scope and interest of the work. Not only will the investigator be rewarded in reading the contributions, but the clinician and general practitioner, likewise, will find them most interesting. This volume will continue to provide useful information for many years to come.

The publishers have arranged the contents in an attractive manner; the type is easily read; the illustrations are excellent. The reviewer can recommend this volume with great enthusiasm.

TUMEURS MALIGNES DU PHARYNX ET DU LARYNX: ÉTUDE ANATOMO-TOPOGRAPHIQUE ET RADIOGRAPHIQUE. By F. BACLESSE, Chef de service du radiodiagnostic et de la radiothérapie à la Fondation Curie (Institut du radium de l'Université de Paris), Chef de service de radiothérapie à l'Hôpital Américain. A volume of 770 pages, with 702 figures. Published by Masson & Cie, 120 Blvd. St.-Germain, Paris, 6e, France, 2d ed., 1960.

From the Curie Institute in Paris comes this well illustrated volume on the various malignant tumors of the larynx and pharynx, based on the clinical experience of the author. He employs four main radiographic methods for the demonstration of these neoplasms: (1) plain films, anteroposterior and lateral; (2) contrast examination, with a thin coating of Lipiodol in the nasopharynx, hypopharynx, and larynx; (3) magnification views; (4) tomography, with lateral cuts in the nasopharynx and anteroposterior in the larynx and hypopharynx.

The book includes chapters on radiographic technic, the normal pharynx, the normal larynx, malignant tumors in the oropharynx, nasopharynx, hypopharynx, larynx, and posterior pharyngeal wall. There is a short section on thyroid tumors involving the larynx, another on laryngocele, and one on the differential features of tuberculosis of the cord and laryngeal papillomas. The final section deals with classification of the various lesions.

In each section there are numerous excellent reproductions of radiographs, usually with accompanying line sketches which graphically present the findings. There are also many drawings of the pathological anatomy as viewed by endoscopy or in surgical specimens. All the cases included had histological confirmation. Adequate legends accompany the radiographs and the textual material has been kept to a minimum, so that the work in general has the character of an atlas.

The author feels that roentgen study of the larynx is a useful adjunct to the clinical examination, making possible a more accurate attack on the tumor by either the radiotherapeutic or surgical method or by a combination of both. It also allows for a more precise evaluation of statistics.

This book represents a most useful reference work on the normal and pathological anatomy of the larynx and pharynx and should be of considerable value both to the radiologist and otolaryngologist.

DAS RÖNTGENSCHICHTBILD. By PROF. DR. MED. A. GEBAUER, Frankfurt am Main, Doz. DR. MED. E. MUNTEAN, Graz, PROF. DR. med. E. STUTZ, Freiburg i. Br., and PROF. DR. med. H. VIETEN, Düsseldorf. A volume of 454 pages, with 894 illustrations on 699 figures. Published by Georg Thieme, Herdweg 63, (14a) Stuttgart, Germany, 1959. Price DM 148.—($35.25). Distributed in United States and Canada by the Intercontinental Medical Book Corporation, New York 16, N. Y.

This comprehensive book is devoted to the theoretical and clinical consideration of one of the important radiographic technics, tomography. All aspects of this modality are covered in detail, and the usual frontal, sagittal, and transverse applications are discussed. Illustrations include plain films, frontal tomograms, and often complementary transverse and/or sagittal cuts, with explanatory legends or drawings.

The book is divided into two parts, prefaced by a short introduction to the subject and a discussion of the value of tomography as a three-dimensional procedure and its clinical application. In the first part, comprising 31 pages, the theory, technic, and special methods are discussed. The second part, comprising 400 pages, is devoted to the clinical applications of tomography, which are covered in great detail. The first chapter deals with bones, starting with the skull (mastoids, sinuses, middle fossa, sella turcica, orbits, mandibular joints) and going on to a discussion of the other parts of the skeleton. Subsequently, the pharynx and larynx are described, and this section is followed by a lengthy and detailed consideration of the thorax and its contents. Chapters are also devoted to the evaluation of tomography in delineation of abdominal organs. There are short discussions of the central nervous system, localization of foreign bodies, and the application of transverse tomography in radiation therapy with respect to tumor localization and the plotting of treatment. A bibliography of 16 pages is appended.

This book has excellent illustrations and its clinical subjects are generally well covered, with lucid legends. It can be recommended to those who are particularly interested in the subject of tomography.

ABSTRACTS OF CURRENT LITERATURE

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

An Arteriographic Study of Cerebrovascular Disease in Man. I. Stenosis and Occlusion of the Vertebral-Basilar Arterial System. John S. Meyer, Sheila Sheehan, and Raymond B. Bauer. Arch. Neurol. **2:** 27–45, January 1960. (Wayne State University College of Medicine, Detroit, Mich.)

The purpose of this paper is to discuss angiographic, clinical, and therapeutic considerations based on a total of 84 cases with vertebral-basilar artery insufficiency and occlusion. Angiographic demonstration of atherosclerosis of the vertebral-basilar system was possible in 35 cases and the diagnosis was verified at necropsy in 13 of the remaining group. In 1 patient with a small infarct of the brain stem, no abnormality was noted at angiography. The technic used was that of Crawford *et al.* (J.A.M.A. **168:** 509, 1958), and the fact that one skilled person performed all the procedures may account for the very low incidence of complications. The clinical diagnosis prior to arteriography was essentially correct in 31 instances and wrong in 5. In 4 cases the clinical symptoms were erroneously assumed to be due to disease of the carotid arteries alone.

The sites and incidence of atherosclerosis in this series were as follows:

1.	Disease limited to basilar artery	11
	(*a*) Stenosis of the basilar artery	5
	(*b*) Occlusion of the basilar artery	2
	(*c*) Elongation, tortuosity of basilar artery	4
2.	Vertebrobasilar stenosis	8
3.	Caroticobasilar stenosis	6
4.	Caroticovertebrobasilar stenosis	3
5.	Vertebral stenosis or occlusion	1
6.	Caroticovertebral stenosis or occlusion	3
7.	Posterior cerebral artery occlusion	3
8.	No abnormality noted	1

The sites of atherosclerosis of the vertebral artery were: the intracranial portion, 2 cases; the cervical portion, 20 times (without spondylosis in 10 cases); the origin from the subclavian, 3 times on the left and once on the right. The disease commonly involves several sites at the same time and may be bilateral. In addition, the carotid arteries and their main branches may show atherosclerotic involvement. Diffuse atherosclerosis of the basilar artery may result in occlusion of its small branches, and all that is apparent on angiography are dilatation and tortuosity of the basilar trunk.

The majority of cases of atherosclerosis of the vertebral-basilar arterial system show diffuse involvement or lesions which are not amenable to surgical reconstruction by extracranial intervention. The typical syndrome of occlusion includes unilateral or bilateral hemianopsia, unilateral or bilateral deafness, coma, stupor, and akinetic mutism, with signs of brain-stem and cerebellar infarction.

Major arterial anomalies of the vertebral system occur in approximately 1 to 2 per cent of persons. Vessels may be absent, rudimentary, or narrowed. Such anomalies must be taken into consideration in the interpretation of arteriographic studies. They may play a part in the production of symptoms when another major vessel is occluded, since they provide little collateral blood flow.

In the normal person the contribution of blood from each vertebral artery remains separate and unmixed after entry into the basilar artery. As a result, partial or "half-filling" of the basilar artery may occur if injection into the vertebral artery is made under low pressure. This may give rise to an impression of stenosis of the basilar artery.

The vertebral-basilar system (*via* the posterior cerebral arteries) supplies the thalamus, peduncles, red nucleus, substantia nigra, and subthalamic nucleus, in addition to the brain stem and temporal and occipital lobes. Hence "coma vigil" or akinetic mutism may occur, owing to thalamic ischemia. Rubral tremor, hemiballismus, hemichorea, tremor, and rigidity may result from ischemia of the red nucleus, subthalamic nucleus, or substantia nigra.

Sixteen roentgenograms; 1 photograph; 1 tracing; 3 diagrams; 3 tables.

Proximal Occlusion of the Anterior Cerebral Artery. J. E. Webster, E. S. Gurdjian, D. W. Lindner, and W. G. Hardy. Arch. Neurol. **2:** 19–26, January 1960. (E. S. G., 1553 Woodward Ave., Detroit 26, Mich.)

Between September 1948 and January 1958, nonfilling or thread-like filling of the proximal portion of one anterior cerebral artery (in 1 case of both arteries) was demonstrated angiographically in 50 patients with neurologic and/or psychiatric signs and symptoms. This was an incidence of 11 per cent as against 2 per cent in routine necropsies. Such inadequate filling may be due to occlusive atherosclerosis or to congenital abnormalities, with a small proximal anterior cerebral artery on one side or the other.

Occlusion of the proximal portion of the anterior cerebral artery is usually associated with hemiparesis with brachial predominance and is often attended by grave disability. In this series there were 11 cases of psychosis with hemiplegia in 2 and chromophobe adenoma in 1; 15 instances of neurosis with hemiplegia in 7; 21 of a near-normal state with some psychosomatic complaints, with hemiplegia in 6; 3 critical cases with hemiplegia in all. Six of the 50 patients have died.

It is necessary to distinguish functional from organic disease, particularly in those patients in whom the psychological manifestations are predominant. This may be done by the use of angiography.

Time, mild sedatives, and tranquilizing drugs may help those with proximal anterior cerebral artery occlusion, but shock therapy may be dangerous and is usually not helpful. Administration of anticoagulants for three to four months has resulted in improvement in a few patients.

Five roentgenograms; 1 photograph; 2 diagrams; 1 table.

So-Called Spontaneous Intracranial Pneumatocele. Giacomo Nori Bufalini. Radiol. med., Milan **45:** 513–526, June 1959. (In Italian) (Istituto di radiologia dell'Università di Firenze, Italy)

A 30-year-old male university student had for three years experienced a "heavy feeling" in the left frontoorbital area, with occasional frontal headaches, which had lately become severe and were associated with difficulty in writing, as well as other signs of motor insufficiency of the right arm. Routine roentgenograms demonstrated free intracranial air and an osteoma of the left frontal sinus. Operative removal of the

osteoma (and of a polyp of the frontal sinus), with closure of a rent in the dura restored the patient's health. The intracranial gas was completely reabsorbed within six weeks from the time of surgery.

Post-traumatic intracranial pneumatocele is not uncommon, but the nontraumatic variety is extremely rare. The author has compiled a listing of cases from the literature. It includes 20 instances resulting from osteoma of various paranasal sinuses and of the orbit, 3 due to neoplasia (pituitary tumor, basopharyngeal fibroma, nasopharyngeal carcinoma), and 8 caused by inflammatory processes (cholesteatoma in 2, purulent mastoiditis in 2, purulent sinusitis in 2, and pneumococcic meningitis and tuberculous caries of the left ethmoid in 1 each.

The location of the intracranial gas may be (1) extra- or epidural, between the internal table and the outer layer of the dura, (2) subdural, between the dura and leptomeninges, (3) subarachnoid, (4) intracerebral, within brain tissue proper, (5) intraventricular, and (6) in more than one of the above sites.

The symptomatology is not characteristic (headaches and perhaps pressure phenomena), though occasionally gurgling sounds may be perceived, and tympany will be elicited on percussion of the cranium. Routine views of the skull are usually diagnostic for the condition itself but additional investigation will be needed to determine the underlying cause. Views of the skull taken in upright position may show displacement of the air.

The (3) subarachnoid and (5) intraventricular types are easily recognized as the images are identical with those in pneumoencephalography. The (1) extradural form gives a falciform radiolucency, fairly limited in size because of anatomical resistance to cleavage. The (2) subdural type also shows a semilunar shape, but the air in addition outlines the cerebral lobes. The (4) intracerebral type exhibits cystic areas of transparency projected over the brain substance.

In the author's case the appearance was of subdural air accumulation. The frequent association with osteoma is attributable to the fact that the tumor grows in a centrifugal manner and thus penetrates into the endocranium. As it expands, portions of its periphery undergo localized atrophy. The absence of intracranial gas in most cases is due to the fact that the growing tumor occludes the communication between the sinus and the nasal fossa.

Ten roentgenograms; 1 table.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Laryngography with an Opaque Medium. V. Lecco, B. Brunelli, and G. Bassani. Radiol. med., Milan **45:** 944–952, October 1959. (In Italian) (Istituto di radiologia dell'Università di Modena, Italy)

Satisfactory results in contrast roentgenography of the larynx demand preparatory medication with an antivagal agent (1 mg. atropine sulfate, injected intramuscularly one half hour prior to the actual procedure) to dry up the secretions. Basic anesthesia is obtained with 1 per cent and 0.5 per cent Novocain (*sic*) sprayed onto the palate, pillars, and through the larynx into the trachea. A round catheter is then inserted (with the help of indirect laryngoscopy) into the trachea, and 5 c.c. of a bronchographic compound (called B 2100 Bracco: a mixture of "Propyliodone" and barium sulfate) is instilled, with the patient in supine recumbency. The patient is asked to cough, then to sit up, and another 5 c.c. of contrast material is instilled, this time into the laryngeal vestibule. Brisk inhalation will again provoke the coughing reflex. At this point, the contrast material is usually well distributed in a fine film coating the entire larynx. Roentgenograms in two perpendicular projections (frontal and lateral) are taken at about 60 kv and 60 mas (exposure time two or three tenths of a second with the tube at 72 inches. In heavier patients, the kilovoltage would have to be raised. Body-section views may also be obtained, but are advised only after examination of the conventional exposures, when some questionable finding requiring further elucidation has been elicited. The authors have had excellent results with this procedure in several "tens" of patients. A few cases are illustrated in the paper.

Eleven roentgenograms; 8 diagrams.

E. R. N. GRIGG, M. D.
Cook County Hospital, Chicago

THE CHEST

Segmental Localization of Pulmonary Disease. Gerald W. Parker, Harwood N. Sturtevant, Joel E. Reed, and Robert A. Flaherty. Am. J. Roentgenol. **83:** 217–226, February 1960. (Lackland Air Force Base, Texas)

With acute pneumonic consolidation, the segmental anatomy of the lung is well demonstrated roentgenographically. Reasonably accurate localization of the involved segment is possible from a postero-anterior film alone. The present study is based upon 4,500 cases of pneumonia observed over a period of three years, and the appearance of the pneumonic process is described and illustrated.

Right Upper Lobe: Apical segment: The shadow is in the medial portion of the extreme apex and blends into the shadow of the superior mediastinum. *Posterior segment:* The shadow extends obliquely upward and outward from the right hilus into the infraclavicular area. It lies above the horizontal fissure and is distinct from the hilus. *Anterior segment:* The shadow is sharply outlined inferiorly by the horizontal fissure. The ascending aorta and right hilar shadows may be indistinct, since these are contiguous structures (hilar shadow sign).

Right Middle Lobe: Lateral segment: The horizontal fissure outlines the shadow above and it then fades inferiorly and medially. *Medial segment:* The shadow blends with the right cardiac border and may extend to the anteromedial portion of the right diaphragm. It becomes indistinct laterally and superiorly. The lower portion of the right hilus is indistinct.

Right Lower Lobe: Superior segment: Infiltration of the entire segment produces a shadow in the right mid lung field above and below the horizontal fissure. Often involvement is only subsegmental and is confined to an area behind the right hilus. The right heart border and ascending aorta remain distinctly outlined.

Medial Basilar Segment: Since this segment lies posterior to the heart, the cardiac border is well outlined as a semicircular density. *Lateral basilar segment:* The shadow extends from the right hilus laterally and downward but does not reach the costophrenic sulcus. The diaphragm is well outlined. *Posterior basilar segment:* A triangular shadow along

the right heart border has its base below the diaphragm. *Anterior basilar segment:* Since this segment lies anteriorly, the lateral portion of the diaphragm is obliterated.

Left Upper Lobe: Apical posterior segment: The infiltration is present in the medial and upper portions of the lobe. It extends upward to the apical pleural line and medially it blends into the shadow of the left superior mediastinum. *Anterior segment:* The process is poorly defined on all borders, extending into the lateral retro- and infraclavicular areas. The superior pole of the left hilus is obliterated. This does not happen when the superior segment of the left lower lobe is involved, since it is behind the hilus.

Lingula: The shadow blends with the heart border and extends laterally and inferiorly. The upper margin is poorly defined. *Inferior segment:* Here the shadow blends with the middle and lower portions of the left border and may extend downward to the mid portion of the left diaphragm.

Left Lower Lobe: Superior segment: A density is seen in the left mid lung field not extending to the lateral chest wall. Cardiac and hilar margins remain clear. *Posterior basilar segment:* Localization is behind the heart and therefore the infiltration can be seen only when the film is properly exposed. *Lateral basilar segment:* The shadow is close to the cardiac apex and sometimes extends below the diaphragm. Since it is posterior, the heart and diaphragm are clearly outlined. *Antero-medial basilar segment:* The shadow occupies approximately the same position as the anterior basilar segment on the right. The lateral half of the diaphragm is obscured.

Twenty-two roentgenograms; 4 drawings.

MAX EICHWALD, M.D.
Encino, Calif.

Roentgenographic Determination of Total Lung Capacity. A New Method Evaluated in Health, Emphysema and Congestive Heart Failure. Howard J. Barnhard, John A. Pierce, John W. Joyce, and Joseph H. Bates. Am. J. Med. **28:** 51–60, January 1960. (University of Arkansas Medical Center, Little Rock, Ark.)

A new method for the roentgenographic determination of total lung capacity is described. This requires postero-anterior and lateral views of the chest and principally involves the summation of a series of elliptical cylindroids into which the lungs are divided. The authors consider the procedure simple, rapid, and accurate.

Measurements of total lung capacity determined with this roentgenographic method were compared with those obtained by conventional physiologic studies in 74 persons. A high degree of correlation was found in healthy subjects, young and old, and in patients with congestive heart failure. A significantly lower correlation was attained in patients with emphysema.

The mean total lung capacity in the emphysema group was 0.81 liter more by the roentgenographic method than by the spirometric nitrogen dilution technic. This discrepancy is attributed to errors in the measurement of the residual volume by the dilution method. It is believed to be evidence also of a more severe alteration of the volume elastic properties of the lungs in emphysema than has been indicated previously.

Seven figures, including 2 roentgenograms; 3 tables.

Selective Bronchography. Walter T. Bessler and Robert R. Renner. Am. J. Roentgenol. **83:** 297–301, February 1960 (R. R. R., Doctors Hospital and Clinic, Cleveland Heights 6, Ohio)

The authors describe their technic for selective bronchographic examination of a lung, lobe, or segment. They use the specially constructed Metras catheter (one designed for the left lung, one for the right), with a radiopaque tip for fluoroscopic control.

Various contrast agents in bronchographic use are discussed. The authors prefer aqueous Dionosil because of its good bronchial coating effect, rapid absorption and excretion, and the possibility of its viscosity if supernatant fluid is poured off before instillation. Aqueous Dionosil is less likely to form lung granulomata than Dionosil Oily.

The indications for selective bronchography are listed as "(1) failure to fill an area of interest by routine methods, (2) anticipation of such failure in an area of disease localized to one side, (3) definitive localization of pathology for surgery."

Seven roentgenograms; 1 photograph.

CAPT. ALLAN E. GREEN, JR., M.C.
Lackland AFB, Texas

Vascular Measurements of Smokers and Nonsmokers: Differences Seen in Posteroanterior Roentgenograms Made with Patients Standing Erect. Josue Pagan-Carlo. J.A.M.A. **171:** 2182–2184, Dec. 19, 1959. (3500 Prytania St., New Orleans 15, La.)

Pulmonary arterial diameters were measured on chest films of 694 asymptomatic smokers and nonsmokers. Statistical analysis of the results showed that there was a significant difference in the measurements in the main hilar zone of heavy smokers as compared to nonsmokers. This is interpreted as being possibly due to the chronic vasoconstrictor effect of nicotine on the smaller pulmonary arteries, resulting in pulmonary hypertension. No significant difference was seen in the vascular markings of light and moderate smokers as compared to nonsmokers.

One table.

WILLIAM MARTEL, M.D.
University Hospital, Ann Arbor, Mich.

Intralobar Pulmonary Sequestration. Daniele Salvioni and Ralph R. Goldin. Dis. of Chest **37:** 122–124, January 1960. (Bronx Municipal Hospital Center, New York, N. Y.)

Intralobar pulmonary sequestration is a developmental anomaly in which a portion of the lung tissue receives an independent blood supply from the aorta, usually near the level of the diaphragm. This portion of lung is not functioning and undergoes cystic changes.

The authors report a case in a 16-year-old Puerto Rican girl with repeated upper respiratory infections and recent hemoptysis but no sign of tuberculosis. There was radiographic evidence of a cystic mass in the right lower lobe which did not communicate with the bronchial tree but displaced some of the basilar branches. The sequestration of a portion of the right lower lobe was confirmed surgically.

There is speculation as to whether the mode of origin of the anomalous artery is responsible for or secondary to the pulmonary sequestration. The sequestrated lung is usually well demarcated from the surrounding pulmonary tissue and may consist chiefly of normally differentiated lung, a solid mass of bronchi, or multiple cysts.

The diagnosis of an intralobar pulmonary sequestration should be considered where there is sharply demarcated multicystic density in either of the lower lobes, with a tapering projection directed toward the aorta.

The distribution of the lesion is not segmental. The walls of the cyst are usually thin and not always well visualized. Bronchograms reveal displacement of some of the bronchial branches and failure of the opaque medium to enter the area of the lesion. This tends to rule out bronchiectasis.

The usual discovery of sequestration at an early age (before thirty) is of significance in excluding neoplasm. Barium studies of the gastrointestinal tract may be required for differentiation from hernia through the foramen of Bochdalek.

Three roentgenograms. GORDON L. BARTEK, M.D.
Grand Rapids, Mich.

Pathognomonic Signs of Chronic Bronchitis. Vincent S. Oliva, Charles G. Spradley, and S. F. Williams. Am. J. Roentgenol. **83:** 274–278, February 1960. (U. S. Naval Hospital, San Diego 34, Calif.)

The clinical, pathologic, and roentgenographic features of chronic bronchitis are discussed, and a case is reported in which bronchograms demonstrated two findings which the authors consider pathognomonic of this disease: (1) bronchial gland dilatation manifested by irregular outpouchings from the bronchial lumen (bronchial adenolectasis) and (2) the presence of small (3–5 mm.) cystic lesions with narrow necks arising from terminal bronchi. This latter finding has been referred to as bronchiolectasis but is better designated bronchiolar diverticulosis. The walls of the cysts contain strands of muscle and are lined with respiratory epithelium. They are probably produced by recurrently increased intrabronchial pressure associated with chronic cough acting upon points in the bronchial wall weakened by ulceration and infection. Their infrequent demonstration is probably due to difficulty of retrograde filling of the narrow necks with contrast material.

Other radiographic findings in chronic bronchitis are distortion of bronchial walls with abnormal changes in caliber on inspiration and expiration, alternate narrowing and dilatation ("beading") of the bronchial lumen, poor filling of small peripheral bronchi, and associated pulmonary emphysema and fibrosis.

Four roentgenograms; 2 drawings.
CAPT. ROBERT E. WILDIN, M.C.
Lackland AFB, Texas

Bronchiolar Ectasia: A Report of Twelve Cases. Harwood N. Sturtevant and Harris W. Knudson. Am. J. Roentgenol. **83:** 279–282, February 1960. (Lackland Air Force Base, Texas)

Bronchiolar ectasia or bronchiolectasis refers to saccular dilatation of the terminal bronchioles. It has been observed as a relatively common finding in chronic bronchitis. The authors reviewed 523 bronchograms at a U.S.A.F. hospital and found 12 cases of bronchiolar ectasia. All of the patients had symptoms compatible with chronic bronchitis or bronchiectasis except one who had persistent pneumonitis in the posterior aspect of the right upper lobe. Three patients had bronchiectasis in addition to the bronchiolar changes.

In the cases reported, bronchograms showed relatively narrowed terminal bronchioles with outpouches or pooling of contrast material. The individual dilatation was typically spherical with relatively smooth and well defined margins. There was no distinct segmental distribution. In some cases, the peripheral pooling was diffuse and widespread, while in others less involvement localized in one or more separate areas was noted. The condition may be reversible. Alveolar filling could be distinguished by its irregular snowflake or lace-like pattern.

[The finding described here has also been designated "bronchiolar diverticulosis." See preceding abstract.]

Ten roentgenograms.

JOHN P. FOTOPOULOS, M.D.
Northwestern University Medical School

Epidemic Pulmonary Histoplasmosis. Roentgenographic Findings. Donald P. Babbitt and Burton A. Waisbren. Am. J. Roentgenol. **83:** 236–250, February 1960. (Milwaukee Hospital, Milwaukee 3, Wisc.)

The authors report an epidemic outbreak of acute histoplasmosis in the community of Walworth, Wisc. A group of men became infected while on a construction job at which they were exposed to soil.

The series consists of 19 cases, each of which is described in detail. The duration of exposure was from half an hour to eight hours. The incubation period ranged from seven to sixteen days. In 2 cases the diagnosis was established by the isolation of *Histoplasma capsulatum*. Remaining cases were diagnosed by complement-fixation tests. The most prominent clinical picture was one of acute onset of malaise, fever, weakness, headache, and cough. Although the illness may be severe and the x-ray findings extensive, recovery occurs in most instances. There was no fatality in this group.

The roentgen findings are described as scattered, poorly demarcated nodular infiltration throughout both lung fields with associated enlargement of the hilar lymph nodes. In very mild cases only hilar node enlargement is noted. Pulmonary findings appear more pronounced a week or two after onset of clinical symptoms. Follow-up films up to two and one half years after the acute phase showed no evidence of calcification.

Definite diagnosis of histoplasmosis cannot be made from roentgenograms alone but the disease should be suspected with a history of exposure of the fungus so prevalent in soil. The diagnosis is corroborated by skin tests, complement-fixation tests, and/or lymph node biopsy.

Forty-four roentgenograms.

MAX EICHWALD, M.D.
Encino, Calif.

Value of Tomography in Management of Pulmonary Tuberculosis (A Review of 1,276 Tomograms of 930 Patients). V. V. S. Pratapa Rao. Indian J. Radiol. **14:** 6–12, February 1960. (Military Hospital, Aundh Camp, Poona, W. Indian Union)

A series of 1,276 tomographic examinations on tuberculous patients is reviewed. The usefulness of this procedure in diagnosis of the disease, its management, and the disposal of cases, is stressed. Tomography was helpful in demonstrating the extent and appearance of cavitation or caseation, unmasking hidden or questionable lesions of the apices, assessing the response to

chemotherapy, and in the preoperative localization of lesions to its proper bronchopulmonary segment.

The following observations were made:

1. Persistent cavitation after six months of chemotherapy in 23 per cent of the cases.
2. Cavitation where none was suspected from plain films in 16 per cent.
3. Fibrosis with bronchopulmonary distortion which was only faintly visible on plain films, in 6 per cent.
4. Bronchiectatic changes in the affected segmental bronchi in 5 per cent.
5. Calcification in the area of involvement in 4 per cent.
6. Parenchymal infiltration in 51 per cent.
7. Two cases of lung cyst: one a simple cyst filled with blood, the other a hydatid cyst.
8. Three cases of vascular markings mimicking cavitation.

Tomographic depths for best visualization of specific lobe areas on anteroposterior, oblique, and lateral views were calculated and are presented in tabular form.

One table. CAPT. ALLAN E. GREEN, JR., M.C.
Lackland AFB, Texas

Unsuspected Bronchogenic Carcinoma. James W. Pate, Roger E. Campbell, and Felix A. Hughes. Dis. of Chest **37:** 56–60, January 1960. (VA Hospital, Memphis, Tenn.)

The authors report a series of 32 cases of bronchogenic carcinoma in which the diagnosis was not seriously considered before death. These errors occurred in 650 cases of bronchogenic carcinoma from 150,000 admissions. The presenting complaints were variable, ranging from joint pain to gastrointestinal symptoms. The physical examination revealed neurological defects in 13 of the 32 cases and chest abnormalities in 8. Negative routine chest films were obtained in 6 cases; soft infiltrations suggestive of tuberculosis or pneumonia were present in 13 with clearing in 5 during hospitalization. Bullous emphysema was found in 5 cases. The sputum was positive for tuberculosis in about a third of the series, and that diagnosis was entertained in about one-half of the total.

Metastases were extensive, involving the liver, adrenals, bone, brain, heart, spleen, gastrointestinal tract, kidneys, thyroid, and skin. From 16 to 38 per cent of metastatic brain tumors are said to be bronchogenic in origin.

The authors feel that a study of the errors reported here indicates that spinal or brain compression, joint pain, and pulmonary tuberculosis should make one cognizant of the possibility of coexisting bronchogenic carcinoma.

Two figures. GORDON L. BARTEK, M.D.
Grand Rapids, Mich.

Thoracic Roentgen Hypertransparency During Asphyxic Syndromes in Infancy. Gianfranco Vichi and Cesare Cavina. Radiol. med., Milan **45:** 609–633, July 1959. (In Italian) (Istituto di radiologia dell'Università di Firenze, Italy)

Since 1951, the authors have performed over 15,000 x-ray examinations of the chest in children. On the basis of this material, but without statistical studies, they discuss the pathogenesis and roentgen appearance of pulmonary hypertransparency in infants. A listing of conditions in which this occurs, admittedly incomplete, is given:

1. *Gigantic congenital cysts* are apparently exceptional; none was found in this series.
2. *Gigantic alveolar emphysema* (64 cases in the literature up to 1958) is an irreversible alveolar dilatation involving more often the left upper lobe. Two instances are illustrated here, but they lack pathologic confirmation.
3. *Acquired obstructive lobar emphysema*, due to (*a*) endobronchial obstruction (mucous plugs, foreign bodies, perforated lymph nodes); (*b*) intrabronchial changes (thickening of the bronchial mucosa, torsion or kinking of the bronchial wall); (*c*) extrabronchial factors (compression by enlarged lymph nodes, cysts, or tumors).
4. *Pneumatocele* is often a result of staphylococcic infection. When under tension, it may occupy an entire hemithorax, which makes differentiation from pneumothorax difficult.
5. *Pneumomediastinum.* Air may reach the mediastinum (1) from the interstitial pulmonary tissues, (2) along the fascial planes of the neck, (3) through perforations of the trachea, bronchi, or esophagus, and (4) following cleavage of retroperitoneal spaces. The first of these routes (*a*), due to rupture of alveoli, is the more frequent. The roentgen appearance depends on the amount of air in the mediastinum. Spontaneous pneumomediastinum in the newborn is a rare condition, resulting from mechanical obstruction of the alveoli (meconium, mucus) or disturbances in respiratory dynamics due to cerebral damage.
6. *Pneumothorax* is usually referable to rupture of a bleb or bulla, but occasionally it is of obscure etiology, as in the case of bilateral involvement in the newborn. In the absence of a basilar fluid level, differentiation from pneumatocele may be difficult. Sacculated levels are encountered in pyopneumothorax.
7. *Diaphragmatic hernia.* The bowel pattern in the chest is typical, but one must bear this condition in mind if he is to recognize it.

Thirty-two roentgenograms.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Idiopathic Pulmonary Hemosiderosis in Adults: Report of a Case and Review of the Literature. S. Martin Bronson. Am. J. Roentgenol. **83:** 260–273, February 1960. (VA Hospital, Atlanta, Ga.)

In idiopathic pulmonary hemosiderosis phagocytized and free hemosiderin is found in the alveoli, the alveolar and capillary walls, the bronchial walls, and the mediastinal lymph nodes. The alveolar walls and the interlobar and peribronchial connective tissues are thickened. Destruction of the elastic fibers of alveolar walls and capillaries is also seen.

A new case of idiopathic pulmonary hemosiderosis in a 21-year-old white male is presented, with a six-year follow-up. In addition, 37 adult cases from the literature are reviewed. The oldest patient was fifty-three years old, while the youngest was ten. Twenty-seven males and 11 females comprised the series. It has previously been noted that in children the disease is more common in girls.

Presenting complaints are usually referable to either a marked anemia or the infiltrative pulmonary process (*i.e.*, shortness of breath, fever, cough, cyanosis, hemoptysis). Acute symptoms last from hours to

days and slowly subside. Symptoms are usually recurrent at intervals of a few months. However, death may ensue rapidly with massive pulmonary hemorrhage. The longest reported survival has been twenty years. In this series, the average interval between the appearance of pulmonary infiltration and a fatal outcome was three and a half years. Treatment is supportive only. Splenectomy occasionally seems to help in children. Cortisone and ACTH appear to be of little value.

The characteristic laboratory finding is a hypochromic microcytic anemia. The bone marrow is normal or shows slight erythroid hyperplasia. Serum iron is low and the iron fixation capacity is high. Of the greatest diagnostic significance is the appearance of hemosiderin-laden macrophages in the sputum or in the fasting morning gastric aspirate.

Radiographically, the pattern in the lungs resembles miliary tuberculosis, sarcoidosis, carcinomatosis, and pneumoconiosis. Abnormal chest roentgenograms were noted in 20 of 32 cases (62 per cent). In 11 of 12 patients with initially normal chest films an abnormal appearance subsequently developed. The typical picture is one of bilateral nodular infiltration with a "ground glass" appearance, the perihilar and lower lung fields usually showing the maximal density. The size of infiltrates varies from a few millimeters to 2 or 3 centimeters in diameter. During an acute phase, diffuse homogeneous densities are noted. Hilar adenopathy and pleural effusions are rare.

An atypical pattern, consisting of large, dense, confluent, peripheral lesions, was present in 4 of the reported cases. Rarely, the process is unilateral. The infiltrates usually show some clearing during a remission.

The pathogenesis is unknown. Multiple etiologies are suggested.

Six roentgenograms; 1 table.

CAPT. JOHN R. BROADWATER, M.C.
Lackland AFB, Texas

The Roentgenographic Appearance of Eosinophilic Lung (Tropical Eosinophilia). F. Y. Khoo and T. J. Danaraj. Am. J. Roentgenol. **83:** 251–259, February 1960. (15 Ross Ave., Singapore 11, Malaya)

This is a report of 550 cases of tropical eosinophilia seen in Singapore. The disease is said to be found only in the tropics and is endemic in India, Malaya, and Southern Asia. Its peak age incidence is twenty to forty, but it is found also in children and the elderly. There is no apparent occupational etiologic factor and no specific bacterial, mycotic, or parasitic organism has been incriminated.

Patients complain of chronic paroxysmal cough, fatigue, weight loss, low fever, and a sense of suffocation. Physical examination reveals coarse crepitant râles and rhonchi over the lung bases. Eosinophilic leukocytosis is always present (eosinophil count, 3,000–5,000 per cu. mm. or higher). The erythrocyte sedimentation rate is usually elevated.

The chest roentgenogram shows increased markings and mottled densities (varying from size of a pin head to 4 mm. in diameter), predominantly in the basal and mid-lung zones. The apical areas are usually normal. Hilar and mediastinal lymphadenopathy is rare. Other common findings are pleural thickening, pulmonary emphysema, pneumonitis, and rib fractures (presumably due to coughing). Differential radiographic considerations include: miliary tuberculosis, bronchitis, bronchiectasis, sarcoidosis, pneumoconiosis, cardiac failure, atypical pneumonia, mycotic infections, carcinomatosis, and Loeffler's syndrome.

Pathologic examination of lung tissue has revealed focal granulomatous reaction with areas of necrosis. Chronic inflammatory cells and foreign-body giant cells are numerous.

The disease is treated with organic arsenicals, chiefly diethylcarbamazine. There is marked clinical improvement and clearing of the chest roentgenogram in one to four weeks. Relapses or recurrences are treated with a second course of arsenicals.

Eight roentgenograms; 2 tables.

CAPT. ALLAN E. GREEN, JR., M.C.
Lackland AFB, Texas

Pleuropulmonary Manifestations in Lupus Erythematosus Disseminatus. Jon R. Myhre. Acta med. scandinav. **165:** 55–60, 1959. (University Clinic, Bergen, Norway)

This paper is concerned chiefly with the clinical and roentgen findings in the respiratory tract associated with lupus erythematosus disseminatus. Pleuropulmonary changes appeared in all but 2 of the 18 cases studied. In one case these were the primary manifestation of the disease. In 14 cases, joint pain was the initial complaint, and in 3 cases skin eruptions occurred first. The pleuropulmonary affection was unilateral at first in 6 cases but in 5 of these, weeks or months afterward, changes were seen on the other side also. In the remaining 10 cases involvement of the respiratory tract was bilateral when first observed.

The pleuropulmonary lesion often appears months or years after the onset of the disease but cannot be considered a preterminal or terminal event. In the basal portion of the lung uneven and ill-defined opacities of varying size and density appear, together with a pleural effusion of small or moderate size. The diaphragm tends to rise, and the elevation is often unusually marked in proportion to the pleuropulmonary changes. "Plate-shaped" shadows of the type usually considered to be of an atelectatic nature tend to develop in the basal lung field. On improvement the diaphragmatic elevation generally persists much as before.

Though the separate components of the pleuropulmonary manifestations in lupus erythematosus disseminatus are not specific, together they constitute a clinico-roentgenological syndrome which may be more characteristic than is generally appreciated.

In an Addendum, the author mentions another example of pleuropulmonary lupus erythematosus which he has seen. This patient, a 53-year-old male, was assumed to have a subdiaphragmatic abscess; he underwent two exploratory laparotomies before the correct diagnosis was made. Lupus erythematosus disseminatus should therefore be included among the possibilities to be considered before a diagnosis of subdiaphragmatic abscess is made in obscure cases.

Fourteen roentgenograms; 1 table.

Tracheopathia Osteoplastica. John S. Shuttleworth, Cameron L. Self, and Hugh S. Pershing. Ann. Int. Med. **52:** 234–242, January 1960. (J. S. S., U. S. Public Health Service Hospital, Norfolk, Va.)

Tracheopathia osteoplastica is an unusual disease, characterized by osseous and cartilaginous growths

between the tracheal and bronchial rings; this process is usually limited to the lower two-thirds of the trachea. Only some 100 cases have been reported in the world literature since the condition was first described in 1857. The authors add a case, in which involvement was confined to a left main-stem bronchus, without evidence of tracheal change. This distribution of the disease process seems to be unique.

The diagnosis of tracheopathia osteoplastica is made primarily by bronchoscopy. There is marked rigidity of the trachea and bronchi. In early cases the tracheal and bronchial walls may have a beaded appearance, due to the presence of many nodules. As the disease progresses, the nodules may coalesce and form polypoid lesions or large, plaque-like areas. These lesions are invariably covered by an intact mucosa. Tomograms may be useful in diagnosis. They may reveal thickening of the entire tracheal and bronchial wall, the surface of which has a beaded or scalloped appearance, produced by the coalescence of the calcified nodules; they may also show narrowing of the airway.

In the authors' case, in view of roentgen changes consistent with an inflammatory process and the bronchoscopic finding of nearly complete occlusion of the left main-stem bronchus, an attempt to remove the lesion surgically was felt justified. Thoracotomy disclosed a marked inflammatory reaction and fibrosis encroaching upon the left hilus; this necessitated an intrapericardial approach to the pulmonary vessels. During the operative procedure the left pulmonary artery was inadvertently perforated, and the patient died before bleeding could be controlled. The diagnosis of tracheopathia osteoplastica was established at autopsy.

Three roentgenograms; 1 photograph.

THE HEART AND BLOOD VESSELS

Factors Controlling the Rate of Injection of Contrast Media in Angiocardiography. J. W. Laws and J. G. C. Fox. Brit. J. Radiol. **33:** 119–123, February 1960. (Hammersmith Hospital, London, England)

The authors discuss the factors controlling the rate of injection of contrast media in angiocardiography. The effect of the following was considered:

1. *Type of medium.* Three media were considered: Hypaque, 85 per cent, Diaginol 70 per cent (70 per cent sodium acetrizoate), and Urografin 76 per cent. The results indicate that there is little difference in the rate of flow of the three media. The authors use Hypaque 85 per cent routinely at their hospital.

2. *Effect of temperature.* No detectable difference in rate of injection was noted in the temperature range from 100 to 120° F. (37.8–48.9° C.). At lower temperatures, 60° F. (15.6° C.) for example, the flow rate was appreciably reduced. In light of the data presented, it seems unjustified to inject a contrast medium at greater than blood temperature, since to do so may very well increase the risk of toxic reaction or cause hemolysis.

3. *Type of catheter.* Results of testing show that, under comparable conditions, the flow of contrast medium through the N. I. H. (National Institutes of Health) catheter was slightly more rapid than through the Porges catheter and considerably more rapid than through a Cournand, in spite of the fact that the dimensions of the three No. 10 catheters tested were the same. The N. I. H. and the Porges catheters, however, had thinner walls and larger bores than the Cournand catheter. Because of the superior flow rate obtainable with the N. I. H. catheters, these were used for all subsequent experiments.

4. *Size of cardiac catheter.* The results show that for any particular pressure injection, the rate of flow of contrast medium through a No. 10 catheter was over twice as fast as through a No. 8 and over three times as fast as through a No. 7.

5. *Volume of contrast medium and size of syringe.* Three syringes are available with the Talley pressure injector, 25, 50, and 100 c.c. in volume. The stroke of the plunger necessary to empty each is the same so that the cross-section area of the syringe is in proportion to its volume. It might be expected that, in order to get the same flow rate with the 50-c.c. as with the 25-c.c. syringe, twice the pressure would be required, and similarly, four times the pressure with the 100-c.c. syringe. It was found that for the 100-c.c. and 50-c.c. syringes, this expected relationship held, but this was not true of the 25-c.c. syringe. This apparent anomaly was due to the very short duration of the injection. It was found that if 25 c.c. or less of contrast medium were injected, the injection time was shorter with the 25-c.c. syringe than when the same quantity of contrast medium was injected from the 50-c.c. syringe.

6. *Pressure of injection.* The flow of contrast medium through a small catheter was approximately proportional to the applied pressure; the increase obtainable by raising the pressure was small. When the larger catheters were used, however, the relationship between the rate of flow and the applied pressure was not linear, but varied with different levels of pressure. In practice, it has been found that the pressures between 100 and 130 lb. per sq. in. (7.0 to 9.1 kg./sq. cm.) are suitable when the injection is being made into the main cardiac chamber. At pressures greater than this, there is risk of rupture of the catheter, particularly when the smaller syringes are used.

Five figures; 1 table. THEODORE E. KEATS, M.D.
University of Missouri

Ventricular Septal Defect: A Review. Alan S. Deutsch. Dis. of Chest **37:** 98–110, January 1960. (Rochester, N. Y.)

This paper is a prize essay submitted to the American College of Chest Physicians and appears to be based wholly on the literature. Ventricular septal defect was first described in 1879 and with the advent of open-heart surgery has attracted increasing attention. Septal defects may involve the region related to either the inflow or outflow tract and are classified on that basis. The outflow tract, on the right side of the ventricular septum, is divided into superior and inferior regions by the crista supraventricularis. The area inferior to the crista represents the most common site of ventricular septal defects.

Statistics of incidence are difficult to evaluate, since an autopsy series implies some degree of selection. It is generally considered that isolated ventricular septal defects represent between 5.5 and 21 per cent of the cases of congenital heart disease. Males and females appear to be equally effected.

The average history is one of fatigue, shortness of breath, and some retardation of growth. On physical examination the classical sign is a systolic murmur

along the left sternal border, heard best at the 3rd and 4th interspaces. A diastolic murmur may be present on occasion, but most often in combination with the systolic murmur. There is a systolic thrill, and the second sound at the base of the sternum is often accentuated. The left anterior chest may be more prominent than the right. There is general cardiac enlargement, with a visible precordial heave. Cyanosis and clubbing occasionally occur but are never marked.

X-ray evidence of lesser defects, with only a small left-to-right shunt, is first recognized as right ventricular enlargement. Both ventricles increase in size, but the right is more distensible and enlarges first. In patients with larger defects the picture may be a changing one which mirrors progression of the disease. Initially the heart as a whole will be enlarged. With a left-to-right shunt, left ventricular enlargement will predominate, manifested by rounding of the apex and its displacement posteriorly and downward. In the later stages with marked pulmonary hypertension, there will be evidence of enlargement of both ventricles, often with dominance of the right. Normally the right ventricle does not add much to the transverse diameter of the heart, but the hypertrophic ventricle alters the cardiac contour in the postero-anterior film by elevating the left ventricle at its apex and thereby increasing the transverse diameter. Occasionally there will be enlargement of the left atrium. As the disease progresses, the main pulmonary artery will become enlarged, and vascularity of the peripheral lung field will be increased.

The electrocardiogram is of some diagnostic aid and is of significance in establishing the magnitude of the physiologic abnormality, with which it correlates reasonably well.

Cardiac catheterization findings will vary with the stage of the disease. Diagnostic information comes chiefly from determination of pressure and oxygen content in the chambers of the right heart and pulmonary artery. A left-to-right shunt at the ventricular level is present if the oxygen content of the blood from the right ventricle exceeds by 1 volume per cent or more that of the right atrium.

Contrast roentgenologic methods are almost never of value in demonstrating the presence of a ventricular septal defect.

In respect to hemodynamics of this lesion, it is stated that normally the pulmonary resistance is low, and with the force of the contraction of the left ventricle there is a resultant left-to-right shunt between the two ventricles. As this progresses, there is a gradual increase in the pulmonary resistance which increases the right ventricular pressure and decreases the magnitude of the left-to-right shunt. Ultimately the resistance to the pulmonary flow becomes greater than the resistance to the systemic flow and a right-to-left shunt develops, with the appearance of cyanosis.

It has been found by various authors that there are few deaths between the ages of one and fifteen years. Most children with this defect seen at autopsy are less than six months of age, and death has in general been due to congestive heart failure with various degrees of pulmonary congestion and edema and hepatomegaly. Perhaps 50 per cent die as a result of the defect in the first twelve months of life. The remainder go on to adult life to present symptoms at a later date. Pulmonary hypertension is a separate problem in the management of this disease.

The size of the defect is of prime importance in development of pulmonary hypertension, as is its location in the ventricular septum.

A ventricular septal defect may be associated with other defects to produce the Eisenmenger complex. It has been seen also in association with the tetralogy of Fallot.

Prognosis without surgery is considered excellent in the case of a small defect low in the ventricle, with development of almost no pulmonary hypertension. These patients may expect to live a normal life. With the higher, larger defects, it is believed that some 50 per cent may attain adulthood and survive to the age of fifty-five or sixty. In about 25 per cent of these patients a bacterial endocarditis develops, which may prove fatal.

Criteria for surgery are outlined. The repair consists of open heart surgery with a direct closure of the smaller lesions and the use of a polyvinyl-formal sponge cut to size to fill the defect. The mortality rate in a recent series of 154 patients was 29.3 per cent (Lillehei *et al.*: Arch. Surg. **75**: 928, 1957).

Catheterization studies of patients surviving surgery usually show a significant decrease in pulmonary artery pressure, with diminution of the various murmurs. The pulmonary vascularity demonstrable by x-ray soon returns to normal, while the cardiomegaly disappears less strikingly. All of the patients in the series cited were found to have postoperative right bundle branch block. GORDON L. BARTEK, M.D.
Grand Rapids, Mich.

Primary Malignant Tumors of the Heart; Case Report and Review of the Literature. R. Bergonzini and M. Calzavara. Radiol. med., Milan **45**: 865–886, September 1959. (In Italian) (Istituto di radiologia dell'Università di Modena, Italy)

A 32-year old male, with a history of polyarticular rheumatism, was found to have cardiac insufficiency. Clinical and roentgen findings were typical for mitral heart disease (aside from a large liver, passive pulmonary congestion, and right pleural transudate), except that the pleural fluid was persistently bloody and multiple subpleural nodules were seen on the chest roentgenogram. The patient died in heart failure, and autopsy revealed a reticulosarcoma (histocytoblastoma) of the anterior wall of the right ventricle, with extension by contiguity into adjacent lung tissue, and metastases to the lung, pleura, and liver.

After mentioning several previous contributions on the subject of primary heart tumors (for example, Brucker and Glassy: Cancer **8**: 921, 1955) the authors list 38 cases taken from the literature but not included in existing reviews. This brings the total number of cases to 182.

Four roentgenograms, 1 photomicrograph; 1 photograph; 5 tables. E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Diagnostic Pneumopericardium: Its Clinical Application. Elmer R. Maurer and F. L. Mendez, Jr. Dis. of Chest **37**: 13–22, January 1960. (University of Cincinnati College of Medicine, Cincinnati, Ohio)

Introduction of air into the pericardial space has been found to be a valuable diagnostic "tool" that can give useful preoperative information regarding the precise origin of paracardiac, cardiac, pericardial, and contiguous diaphragmatic lesions.

Anatomical and physiological considerations are discussed and an experimental study in dogs is reported. This showed that with rapid instillation of 200 to 250 c.c. of air into the pericardial sac there was a prompt fall in arterial pressure preceded by a slow rise in venous pressure. If, however, the instillation was prolonged for several minutes, these pressure changes were delayed or absent altogether.

On the basis of the experimental findings a technic for pneumopericardium in man was evolved. A 20 or 22 gauge lumbar puncture needle with the stylet in place is inserted 1.5 to 2 cm. to the left of the sternal border in the third intercostal space, and advanced slowly until it encounters the heart. The needle is then withdrawn 2 or 3 mm., a hemostat is placed about it at skin level, and 100 to 500 c.c. of air is slowly injected. The needle is then removed and films are obtained.

Six case reports are given to demonstrate that the preoperative information obtained by diagnostic pneumopericardium permits a direct, accurate, and less time-consuming surgical approach to lesions in and about the heart, pericardium, and mediastinum.

Twelve roentgenograms; 1 photograph.

GORDON BARTEK, M.D.
Grand Rapids, Mich.

Coarctation of the Aorta. Atypical Localization Central to the Origin of the Innominate Artery. M. Eiken. Acta med. scandinav. **165:** 235–238, 1959. (Copenhagen County Hospital, Gentofte, Denmark)

The case is reported of a 33-year-old woman, who had coarctation of the aorta localized at the junction of the ascending aorta and the arch, central to the origin of the innominate artery. Chest roentgenograms showed a cardio-thoracic index of 0.5, signs of mild hypertrophy of the left ventricle with rounding of the apex, and slight displacement of the esophagus. The entire ascending aorta was the site of severe calcification. The calcific shadow tapered upward in the shape of a funnel; in the right oblique position the lumen of the narrowed segment was dimly visualized. Tomography in the left oblique position revealed a fairly short narrowing of the aorta, at the junction of the ascending portion and the arch, apparently with a mild poststenotic dilatation of the remaining part of the arch. There was no dilatation of the ascending aorta. No rib notching and no dilatation of the internal mammary arteries was demonstrated. Because of the pronounced calcification, the case was considered inoperable and angiocardiography was not performed.

Two roentgenograms.

Dilatation of the Aortic Sinuses in the Marfan Syndrome: Roentgen Findings in Five New Cases. Israel Steinberg. Am. J. Roentgenol. **83:** 302–319, February 1960. (New York Hospital-Cornell Medical Center, New York 21, N. Y.)

Marfan's syndrome is a rare hereditary disease of connective tissue transmitted as a simple mendelian dominant trait. Characteristic features include arachnodactyly with hyperextensibility of limbs, scoliosis, kyphosis, funnel and pigeon breast, dolichocephalic skull, large long ears, long face, congenital bilateral dislocated lenses, myopia, and cardiovascular abnormalities. These last, present in 30 to 60 per cent of the patients, include cystic medial degeneration of the great vessels, especially the aorta, producing aneurysmal dilatation of the ascending aorta with rupture and dissection. Coarctation of the aorta, dilatation of the aortic sinuses, endocardial valvular thickening, and cardiac enlargement also occur.

The author found angiocardiography the definitive method for demonstrating dilatation of the aortic sinuses in 9 patients with Marfan's syndrome. In the 7 adults, the horizontal diameter of the aortic sinuses exceeded the average measurement of 30 to 38 mm. (Normal measurements are not available for infants and children.)

Frontal angiocardiograms are presented, showing dilatation of aortic sinuses causing indentation of the inner distal portion of the superior vena cava, the superior right atrium, and the inner pulmonary conus borders. The aortic sinus dilatation in Marfan's syndrome should be differentiated from that associated with coarctation of the aorta, syphilis, and arteriosclerosis.

Twenty-one roentgenograms; 2 photomicrographs; 9 photographs; 1 table.

CAPT. SAMUEL S. KRIKORIAN, M.C.
Lackland AFB, Texas

Isolated Congenital Pulmonic Valvular Regurgitation. Diagnosis by Cardiac Catheterization and Angiocardiography. N. Perryman Collins, Eugene Braunwald, and Andrew G. Morrow. Am. J. Med. **28:** 159–164, January 1960. (National Heart Institute, Bethesda, Md.)

A case of congenital isolated pulmonic valvular regurgitation in a 36-year-old woman is reported. The following clinical features suggested the diagnosis: (1) a murmur discovered in childhood without a history of rheumatic fever; (2) absence of significant symptoms; (3) evidence of increased right ventricular activity on palpation of the chest; (4) prominence of the pulmonary artery on radiologic examination; (5) a low-pitched mid-diastolic murmur and thrill along the left sternal border unaccompanied by a widened systemic arterial pulse pressure, by a prominent systolic murmur, or an accentuated second sound. The diagnosis was established when identical right ventricular and pulmonary artery pressures were recorded during the course of cardiac catheterization. A selective angiocardiogram with pulmonary artery injection revealed reflux of contrast material (70 per cent Urokon) into a dilated right ventricle, further confirming the diagnosis.

In an addendum, the authors mention another case of isolated congenital pulmonic valve which they have studied. In this case severe pulmonic regurgitation was demonstrated by the prompt appearance in the right ventricle of cardio-green dye and radioactive krypton (Kr^{85}) following the injection of these indicators into the pulmonary artery.

Nine figures, including 6 roentgenograms; 1 table.

Pulsations in the Pulmonary Arteries as Observed with Roentgenoscopic Image Amplification; Observations in Patients with Isolated Pulmonary Valvular Stenosis. Brit B. Gay, Jr., and Robert H. Franch. Am. J. Roentgenol. **83:** 335–344, February 1960. (Emory University Clinic, Atlanta 22, Ga.)

The authors report their observations on differential pulsations of the right and left pulmonary arteries as a diagnostic sign of isolated pulmonary valvular stenosis. Twenty cases of this entity were found in 185 patients studied by roentgenoscopy with image amplification at the time of cardiac catheterization.

There is a distinct pattern of pulsations in the pulmonary arteries in patients with pulmonary valvular stenosis. The main pulmonary segment of the left heart border and the left pulmonary artery in the left hilus showed definitely increased pulsations in 15 of the 20 patients, slightly increased pulsations in 2 patients, and normal pulsations in only 3. Two of this last group of patients had low cardiac indices and were in the older age group.

In contrast to the left pulmonary artery, the right descending pulmonary artery branch exhibited intrinsic pulsations in only 5 of the 20 patients. In the remaining 15 patients there were no visible pulsations of this vessel. Pulsations in the basilar branches of the pulmonary arteries were not observed in the right lung base, but varying degrees of pulsations were seen in the left lung base in 11 patients. In 16 of the 20 patients, pulsations in the left hilar pulmonary artery branch were considerably increased in amplitude over pulsations in the right descending pulmonary artery in the right hilus. In only 2 patients in the series of 20 were the hilar and basilar pulsations normal.

Roentgenographic signs in this group of 20 cases of isolated valvular pulmonary stenosis include a normal vascular pattern in all except 2, which showed decreased vascularity. The left pulmonary artery in the left hilus was enlarged to varying degrees in 18 cases.

Conditions in which pulsations simulate pulmonary stenosis include (1) patent ductus arteriosus or aortic pulmonary window and (2) atrial septal defect after operative correction. This same pattern was seen by the authors in 1 case of arteriovenous malformation of the left lung and in 1 patient with rheumatic heart disease with mitral insufficiency and stenosis. It also occurred in a third of their patients with left-to-right intracardiac shunt in association with pulmonary valvular stenosis. No patient with infundibular stenosis showed these unequal pulsations.

The causes for increased pulsations in the left pulmonary artery associated with decreased or absent pulsations in the right descending artery branch in patients with pulmonary valvular stenosis are not known. Pulmonary blood flow to each lung was not altered. Blood pressure in the right and left pulmonary arteries was not found to be unequal. The degree of pressure gradient between the right ventricle and the pulmonary artery is not an important factor. Thinning and increased tension in the main and left pulmonary artery walls may be an acquired factor related to turbulence of the blood flow beyond a stenotic valve. Congenital weakness in the pulmonary artery seems unlikely.

Anatomic relationship of the left pulmonary artery to the main pulmonary artery may be of some significance. The effects of the turbulence of blood flow beyond the stenotic valve would seem to be more likely transferred to the left hilar branch than to the right hilar branch because of the distance and the angle of origin of the right pulmonary artery.

Postoperative observations are limited, but the data suggest that one may expect a slight increase in the pulsatile activity of the right descending pulmonary artery branch after pulmonary valvulotomy, particularly if pulsations in this branch were absent preoperatively. If marked increase in pulsations of the right descending pulmonary branch develops after pulmonary valvulotomy, one should consider the possibility of pulmonary insufficiency or a previously missed septal defect with a post-valvulotomy left-to-right shunt.

Twenty roentgenograms, 3 tables.

JOHN P. FOTOPOULOS, M.D.
Northwestern University Medical School

Coronary Arteriography with the Aid of Acetylcholine. G. Arnulf and P. Buffard. Fortschr. a. d. Geb. d. Röntgenstrahlen **92**: 115–129, February 1960. (In German) (Clinique Claude Bernard, 22, Grande-Rue, Lyon, France)

Ordinarily an opaque solution injected toward the base of the aorta is washed away by a systolic wave and rarely enters the coronary vessels. Only with the aid of transient cardiac arrest can the coronaries be satisfactorily filled.

Acetylcholine has proved to be the most suitable drug to achieve this purpose. Its dosage can be exactly predetermined for the needs in each case. For an arrest of ten seconds the dose in dogs is 0.2 to 0.5 mg. per kilogram of body weight. In patients, however, a much higher dose is necessary (20 to 40 cg. per kilogram of body weight). The drug must be rapidly injected.

Experiments with 300 dogs have proved the innocuous nature of the procedure. As a precaution, however, it is advisable to have the specific antidote, atropine, readily available. A deep anesthesia is recommended, as it simplifies the procedure and tends to prevent complications. A simultaneous electrocardiographic tracing indicates the onset and the duration of cardiac arrest.

It is of further interest that the experiments showed coronary vasodilatation following injection of papaverine plus nicotinic acid. Resection of the preaortic and the subaortic sympathetic plexus had the same effect.

The authors have used the cardiac arrest method in 24 patients so far. It was well tolerated in all. Recommended is a supine position with the left shoulder elevated to effect a right posterior oblique position. A direct needle puncture of the aorta from above is advocated, instead of the customary retrograde catheter method.

In conclusion it is stated that coronary arteriography has proved most valuable in localizing coronary occlusion.

Fourteen roentgenograms; 6 tracings.

ERNEST KRAFT, M.D.
Northport, N. Y.

The Intramural Coronary Artery on the Angiogram. W. Porstmann and J. Iwig. Fortschr. a. d. Geb. d. Röntgenstrahlen **92**: 129–133, February 1960. (In German) (Institut für Röntgenologie der Charité, Berlin, Germany)

With the aid of coronary arteriography one can demonstrate the exact site of coronary occlusions. Thereby, the surgeon receives valuable information and can predetermine his operative procedure.

A youth of nineteen was shown by retrograde aortic catheterization with a levogram to have a congenital subvalvular aortic stenosis with associated mitral insufficiency. Of special interest in the angiocardiogram was a simultaneous filling of the coronary arteries. Serial roentgenograms revealed a transient filiform narrowing of the anterior descending branch of the left coronary artery. According to an electrocardiographic tracing this narrowing was present only during systole, while in the diastolic phase the width of the artery was normal.

From this observation it is concluded that the course of this vessel was intramuscular instead of epicardial. According to anatomists such a course represents an entirely normal variation, as it occurs in 22 per cent of all cases. The intramuscular segment persistently remains free from arteriosclerotic changes.

Serial roentgenograms taken in rapid succession are necessary for clarification of the rhythmic contraction during the systolic phase. Knowledge of the phenomenon is important, as it suggests a normal branch of the left coronary artery and guards against the erroneous impression of an organic stenosis.

Six roentgenograms; 3 diagrams.

ERNEST KRAFT, M.D.
Northport, N. Y.

Clinical Manifestations of Primary Varicose Veins. II. An Evaluation of Incompetent Communicating Veins Diagnosed by Tilting Phlebography. Frits R. Mathiesen. Acta chir. scandinav. **117:** 468–479, 1959. (Rigshospitalet, Copenhagen, Denmark)

The purpose of the investigation described here was to determine if incompetence of the communicating veins *per se* exerts any influence on the symptoms in untreated patients with varicose veins. Tilting phlebography was performed in 275 patients, in whom studies on the deep veins have previously been reported (Acta chir. scandinav. **116:** 155, 1959. Abst. in Radiology **73:** 809, 1959).

According to both theoretical considerations and experimental investigations, tilting phlebography should render it certain that all incompetent communicating veins are visualized. A total of 516 communicating veins were revealed in 140 operated cases; of this number 424 were verified surgically. In 20 patients operation on the communicators demonstrated was considered inadvisable. It is emphasized that use of the operative findings as a control in evaluation of the phlebographic examination involves a measure of uncertainty. Of the nonverified communicators, 21 were visualized again at a later phlebographic examination and at a clinical check-up. If these 21 communicators are included, the total of verified communicators increases to 445 out of the 496 demonstrated (and operated upon), *i.e.*, 90 per cent. It is not known, of course, how many incompetent communicating veins were overlooked both at phlebography and operation. Repeat phlebography in the 20 patients who were not operated upon disclosed 17 incompetent communicating veins which had not previously been recognized. From his experience in more than 700 examinations, the author concludes that tilting phlebography is reliable for demonstrating incompetent communicating veins which cannot be detected by other phlebographic or clinical methods.

Disregarding the great and small saphenous veins, a total of 935 incompetent communicating veins were demonstrated. The average figure was 3.4 per leg with varicose veins. The figure was a little higher (3.8) among the patients who had previously received injections of sclerosing solutions, and a little lower (3.0) among previously untreated patients without demonstration of muscular collaterals in the phlebogram; this must be taken as evidence in support of the assumption that treatment with sclerosing solutions may result in incompetence of previously normal communicating veins without cure of the varicose lesions. Of the incompetent communicators, 47 per cent were found on the medial aspect of the lower half of the leg, both in patients with leg ulcers and in those with only a feeling of heaviness, fatigue, or pain. A closer evaluation of cases of untreated varicose veins without muscular collaterals and without previous varicophlebitis showed that many (and, presumably large) incompetent communicating veins were present when the varicosity had produced severe complications. The differences disclosed were relatively moderate, which may be explained, *inter alia*, by the fact that the patients studied also exhibited incompetence of the great saphenous vein at its termination in the groin.

The results of this investigation are consistent with a simple mechanical conception of the muscle-vein pump of the leg, according to which incompetence in the thigh and lower leg may be equally harmful. The size of the varicosities may also to some extent influence the discomforts and complications which develop, but no correlation between the size of the varicose lesions and the incompetence of the communicating veins was apparent. Nor did there seem to be any relationship between the incompetent communicating veins and fine muscular collaterals in the phlebogram. Thus, these conditions cannot explain the results of the investigation, and it must be assumed that incompetence of the communicating veins must have an independent accentuating influence on the discomforts and complications caused by primary varicose veins.

Two roentgenograms; 5 tables.

Internal Mammary Phlebography. A. Tetti and C. Valenti. Ann. radiol. diag. **32:** 39–46, 1959. (In Italian) (Istituto di radiologia dell'Università di Torino, Italy)

The internal mammary veins can be demonstrated following injection of 15 to 20 c.c. of an angiographic medium into the spongy bone of the sternum. Roentgenograms are preferably taken with a seriograph, since incomplete filling or spasm may make single films inadequate for evaluation. The procedure is illustrated by a case which showed external pressure on the middle third of the left internal mammary vein, assumed to be due to enlarged lymph nodes. The examination was executed preoperatively in the presence of known carcinoma of the left breast. The authors intend to use this type of intrasternal phlebography in a series of cases to determine its diagnostic value.

Two roentgenograms; 1 diagram.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Angiographic Studies of the Anatomy of Single and Multiple Renal Arteries. Erik Boijsen. Acta radiol. Suppl. 183, 1959. (Roentgen-Diagnostic Department of the University Hospital, Lund, Sweden)

Part 1: Single Renal Artery: The course of a single renal artery from its origin to the renal hilus was studied in 314 kidneys *in vivo*, and the ramifications of the artery in 427. In clinical angiograms the origin, course, and segmental supply of the branches of the artery were determined in 133 kidneys of which 33 were examined in more than one projection. Twenty-three kidneys were removed at autopsy and examined in 3 projections.

On the right, the renal artery usually ran a horizontal or descending course from the aorta to the hilus. On the left, it followed a horizontal or ascending path. It entered the upper part of the hilus cranial to the renal pelvis. In ptosis it almost always pursued a descending course, though in a few cases of slight ptosis it

ran horizontally. The artery arises at the level of the lower margin of the first lumbar vertebra and takes a laterodorsal course. Because of this, in the frontal view branches of the artery medial to the hilus were not as frequently seen in clinical angiography as at autopsy. In 7 per cent of all kidneys a branch arose early from the renal artery. This has practical importance in selective renal angiography.

The origin, course, and distribution of the branches of the renal artery had a sufficiently characteristic pattern that it was possible to distinguish between dorsal and ventral arteries in a film taken in one plane. In the nephrograms the pyramidal arrangement could be seen.

The kidney is made up of fourteen pyramids, seven dorsal and seven ventral, and is divided into three parts by two sulci, the sulcus interpartialis superior and inferior. These sulci are seen in over 80 per cent of all adult kidneys.

In discussing the arterial segmental supply, however, four segments are recognized: (1) the two most cranial pairs of pyramids, (2) the two most caudal pairs of pyramids, (3) the three middle ventral pairs of pyramids, and (4) the three middle dorsal pyramids. In general, a ventral and dorsal supply was recognized in the pars intermedia. These arteries extended superiorly and inferiorly. The dorsal artery supplied predominantly in a cranial direction, encompassing the ventral pyramids, and the ventral artery extended caudally so that the dorsal pyramids in the pars inferior could be supplied. The ventral artery also supplied the dorsal pyramids in the pars superior and ventral parts of the dorsal pyramids in the pars intermedia, but never was it the sole source of supply to the latter. The dorsal artery was smaller than the ventral and was the first branch of the renal artery in 50 per cent of cases.

Part 2: Multiple Renal Arteries: An investigation of the roentgen anatomy of multiple renal arteries was undertaken in a clinical series of 369 patients: 288 were studied by aortic angiography and 81 by selective angiography. Thirty-four kidneys were examined after removal at autopsy. Dystopic and fused kidneys were excluded so that among 639 kidneys, multiple arteries were found in 23.8 per cent. After exclusion of hydronephrotic kidneys due to ureteropelvic junction obstruction, 20.7 per cent with multiple arteries remained.

One hundred and forty-two kidneys with multiple arteries were studied. Apart from their origin and course to the kidney, the supplementary arteries did not differ from the segmental arteries described above.

Supplementary arteries to pyramids 1–2, ventral and dorsal segment, were found in 14.1 per cent of all kidneys with multiple arteries. This is 10 per cent lower than the autopsy figure, due to the presence of arteries so narrow as not to be visualized by angiography. Pyramids 3–5, ventral segment, were supplied by a supplementary artery in 5.6 per cent of the cases. Pyramids 3–5, dorsal segment, were supplied by a supplementary artery in 14.1 per cent, and in two-thirds of the kidneys pyramids 5–8 were similarly supplied. Pyramids 6–7, ventral and dorsal segment, received a supplementary artery in 72.5 per cent of the kidneys with multiple arteries. In 50 per cent the entire pars inferior was supplied, and in two-thirds 25–50 per cent of the renal parenchyma.

The ventral and dorsal supplementary arteries to the middle of the kidney arose close to the main renal artery and ran together with the main renal artery. The supplementary arteries to the upper pole arose above the main artery and ran directly to it without entering the sinus. The supplementary artery to the lower pole varied considerably, from 7 mm. cranially to 135 mm. caudally to the main artery. In the majority of cases it arose close to the main artery and ran a common course in the pedicle to the hilus and thence as a segmental artery. The frequency of the supplemental artery to the lower pole decreased up to 70 mm. with increasing distance distal to the main artery, then increased up to 90 mm. distally. The first group represents persisting mesonephric renal arteries, the second metanephric arteries.

All malrotated kidneys situated at a normal level had a supplementary artery of the metanephric type. The malrotation was attributed to this artery, its extrahilar dorsal branch preventing normal rotation.

The author found no variation in the number of renal arteries in different normal types of pelves. In kidneys with double pelvis or ureteropelvic obstruction, multiple arteries were encountered in 50 per cent. In these, as well as in dystopic and fused kidneys, aortography is preferred to selective renal angiography.

Part 3: Extrarenal Arteries Arising From the Renal Artery: Angiographic studies were made of the extrarenal arteries arising from the renal artery or its branches or from supplementary arteries in 33 kidneys removed at autopsy. The findings were then compared with selective renal angiography in 90 kidneys.

The inferior phrenic artery, the superior suprarenal, the middle suprarenal, and occasionally the inferior suprarenal and superior capsular artery had an early origin and therefore were seen less frequently in the selective angiographic examinations than at autopsy. Aortography is therefore recommended for studies of adrenal tumors. Part of the adrenal gland can be visualized if the density of the contrast medium is high in the inferior suprarenal artery. This varies with the position of the catheter.

The superior capsular artery runs a tortuous course along the lateral border of the kidney. Its extent varies considerably. It is liable to be displaced by space-occupying lesions of the kidney. The middle capsular artery may be displaced by tumors, or by the renal pelvis in hydronephrosis. These vessels are often dilated in the presence of tumors and inflammation.

The renal pelvic arteries are not seen due to their small caliber. In pyelonephritis, however, hypervascularity may be apparent in the area of the renal pelvis as an accumulation of contrast media.

The ureteral artery was visible only when it was dilated. This occurred, on occasion, in renal carcinoma, cancer of the renal pelvis, tuberculosis, and chronic pyelonephritis. Urografin 60 per cent was used in 5 to 10 ml. amounts depending on the size and function of the kidney. In clinical angiography vessels less than 0.3 mm. in diameter are not visualized.

Fifty-six figures, including 86 roentgenograms; 16 tables.

HAROLD A. SWANSON, M.D.
Calgary General Hospital, Calgary, Alta.

THE LYMPHATICS

Lymphographic Changes in Lower Limbs with Varicose Veins. Sten Jacobsson and Sven Johansson. Acta chir. scandinav. **117:** 346–350, 1959. (Malmö Allmänna Sjukhus, Malmö, Sweden)

Lymphography was performed in 25 patients, from twenty-eight to sixty-three years of age, with varicose

veins with or without complications. Ten patients had varicosities with slight lower leg edema which disappeared when the leg was rested, but no history of thrombosis or ulcer (Group I). In the remaining 15 patients the varicose veins were complicated by ulcer or thrombosis, or both (Group II). All the patients were studied according to the method evolved by Kinmonth (see, for example, Kinmonth *et al.* J. Fac. Radiologists **6:** 217, 1955. Abst. in Radiology **66:** 311, 1956).

Varicosity was present in 18 of 20 legs examined in Group I. The lymphograms revealed pathologically altered lymphatics in 3 of the varicose limbs, and in 1 no lymphatics could be found. There were 26 varicose limbs in Group II; in 18 an ulcer was or had been present, and 7 of the 18 had a definite history of thrombosis. Of the 11 legs currently displaying varicose veins and ulcer, 8 had pathologically altered lymph vessels on lymphography. In 1 leg no lymphatics could be found. In only 2 limbs with both varices and ulcer did the lymph vessels appear normal. Five of 7 legs with both thrombosis and ulcer had pathologic lymphatics. Of 7 limbs without history of thrombosis or ulcer, 6 were normal on lymphographic examination and in the seventh the caliber of the lymphatics was so small that cannulation was not possible.

Changes in the lymphatics were found not only under the floor of the ulcer, but in other regions as well; this was the case in all the pathologic lymphograms. In the floor of the ulcer there was profuse extravasation of the contrast medium.

It is seen from this investigation that altered lymph vessels were fairly unusual in legs with uncomplicated varicose veins, but very common when varicosity was accompanied by ulcer. The significance of thrombosis for the occurrence of lymphatic abnormalities cannot be judged from this small series. In another series comprised of patients who had recently recovered from deep thrombosis or thrombophlebitis, the lymphatics were normal in all cases. This observation may indicate that thrombosis does not play an important role in producing lymphatic changes.

Eight roentgenograms; 2 tables.

THE DIGESTIVE SYSTEM

A Psychosomatic Approach to Recurrent Abdominal Pain in Childhood, with Particular Reference to the X-ray Appearances of the Stomach. Sv. Heinild, E. Malver, G. Roelsgaard, and B. Worning. Acta paediat. **48:** 361–370, July 1959. (Finsen Institute, Copenhagen, Denmark)

Roentgen examination of the stomach and duodenum was performed in 135 children with recurrent abdominal colic of so-called psychogenic nature. Eighty-one of these patients were re-examined after an interval of three years, and the findings in this group are analyzed. A control series consisted of 34 patients without a history of abdominal colic.

Symptoms attributed to maladjustment occurred in 87 per cent; only 9 per cent exhibited a purely infectious state. Peristalsis was increased in 9 of the patients with colic. Coarse, irregular, or blurred mucosal folds in the body of the stomach, prepyloric part, or duodenal cap were observed in 56 patients (mild in 40 patients, moderate in 9, and severe in 7). Thirty-eight patients had increased peristalsis plus mucosal changes. Of the 81 patients, 65 (80 per cent) had one or more of the above-mentioned changes as compared to 21 per cent of the controls. At the follow-up examination, mucosal changes were still present in 75 per cent and increased peristalsis in 68 per cent. These changes were not present as a new phenomenon at follow-up, except in 2 patients who originally had mucosal changes and later had increased peristalsis as well. One patient who had an ulcer when first seen still had it three years later. The mucosal changes showed radiological improvement in 15 cases and had become worse in 8; in 19 they were unchanged.

Clinically, improvement or complete subsidence of abdominal colic occurred in at least two-thirds of the patients in the three-year period, while abnormal findings were still present roentgenographically in 75 per cent. From this, one may conclude that roentgen changes subside more slowly than subjective complaints, if they do subside entirely.

Two graphs; 4 tables.

Cardiospasm After Pharyngo-Esophageal Resection. A Case Report. Claude Bloch and Walter H. Jacobs. Am. J. Digest. Dis. **5:** 147–154, February 1960. (Mt. Sinai Hospital, New York 29, N. Y.)

The development of cardiospasm after extensive surgical procedures on the neck for a neoplasm is reported. The patient, a 61-year-old male, was first seen in 1935 when a cylindroma of the glottis was treated by radiotherapy. In 1951, a total laryngectomy, thyroidectomy, and cervical esophagectomy were performed because of an infiltrating cylindroma of the larynx. In 1954, after many pedicle graft procedures, a tubular subcutaneous skin tunnel was constructed with the use of inverted anterior cervical skin, epilated by irradiation. In 1956, the patient began to experience oral and nasal regurgitations of foods, especially liquids ingested at a normal or rapid rate in other than small quantities. Symptoms gradually increased in severity for about a year, with loss of weight, intense "hunger pains," and weakness.

Roentgen examination revealed a tubular structure, approximately 8-cm. long and somewhat conical in shape, which connected the oropharynx to the thoracic esophagus at the thoracic inlet. This segment was smoothly contoured and distensible; its filled caliber was about one and a half times that of the thoracic esophagus. At the level of the suprasternal notch, there was a pouch-like evagination on the left anterior aspect of the esophagus. At the level of this surgically produced pseudodiverticulum, the lumen of the esophagus was narrowed, measuring 1 cm. in caliber on maximal distention. Adjacent to the pseudodiverticulum, at the junction of the grafted cutaneous tunnel with the thoracic esophagus, was a 45° posterior angulation of the esophageal lumen for a distance of 2 cm.

The thoracic esophagus was only slightly dilated, measuring 4 cm. in width on maximal distention. Its distal end was narrowed in the region of the esophagogastric junction in a tapered, symmetric fashion. Except for the short, 2-cm., narrowed, conical, distal esophageal segment, which filled only in spurts, the walls of the esophagus were pliable and normally distensible. There was no evidence of a mass lesion in the region of the esophagogastric junction. In the erect position, no gas bubble was noted in the fundus of the stomach.

No remarkable abnormality of the pharyngeal phase of deglutition was apparent fluoroscopically.

On the initial swallow, the pseudodiverticulum filled immediately, after which the barium overflowed and entered the distal portion of the esophagus without appreciable delay. However, for a period of approximately five minutes in the upright position no barium entered the stomach. The esophagus filled like a container from below upward, and after the patient had ingested a total of 8 ounces, the barium overflowed freely through the mouth and nose. In the horizontal position, the barium-filled esophagus emptied in a passive manner freely through the nose and mouth.

The esophagus exhibited no peristaltic activity in any position or during any phase of filling; however, numerous shallow, irregular asynchronous contractions were seen throughout the length of the thoracic esophagus.

The unusual clinical features of this case—(1) the absence of dysphagia, (2) the presence of nasal regurgitation, and (3) the rather minimal degree of esophageal dilatation—are probably related to the absence of a functioning cricopharyngeus muscle.

Four roentgenograms.

Problems for the Radiologist in Diagnosis of Gastric Ulcer. Wendell G. Scott, Bernard S. Loitman, and Harold A. Swanson. J. A. M. A. **171:** 2048–2053, Dec. 12, 1959. (100 N. Euclid Ave., St. Louis, Mo.)

Gastric ulcers may be thought of in three categories: definitely benign, indeterminate, and definitely malignant. When the nature of an ulcer is in doubt, a trial of medical management for two or three weeks is justified. Most benign ulcers will show signs of healing in this interval. If this is incomplete, the medical regimen may be continued for another three or four weeks, until a third examination shows the lesion to have disappeared.

The medical regimen test and serial roentgenologic re-examination showing definite evidence of healing constitute the most reliable means of determining that a penetrating lesion is benign. An exception to this rule may be the patient with histamine-fast achlorhydria; such patients are five times as apt to have an associated cancer and may need immediate surgical treatment. When the possibility of malignancy cannot be dispelled, despite all appropriate laboratory and therapeutic tests, surgical measures become mandatory.

The incidence of malignancy in the gastric ulcer which appears benign radiologically may be extremely low (3–6 per cent). The authors believe, however, that there are no radiologic findings that are pathognomonic of benignancy, though a benign lesion is suggested by (1) protrusion of the ulcer crater beyond the stomach wall, with the demonstration of a smooth ulcer floor and contour; (2) demonstration of mucosal folds radiating into the ulcer crater; (3) demonstration of a narrow band of translucency about the neck of the crater formed by a collar of overhanging mucosal edges (Hampton's line); (4) absence of induration around the base of the ulcer, with pliable adjacent stomach wall and persistence of peristaltic movement through the area of ulceration. Usually two or more of these characteristics form the basis for the diagnosis. The size or location of an ulcer cannot be related to the presence or absence of malignancy.

Thirteen roentgenograms.

WILLIAM MARTEL, M.D.
University Hospital, Ann Arbor, Mich.

Trichobezoar and Gastric Ulcer. Enrique Schwarz. Am. J. Digest. Dis. **5:** 155–158, February 1960. (University of Illinois College of Medicine, Chicago, Ill.)

A case of trichobezoar and gastric ulcer was observed in a 36-year-old schizophrenic woman, who for many years had eaten pubic hair. A large ovoid mass was palpable in the epigastrium. The stools were black and filled with hair; the guaiac test was strongly positive. Roentgen examination of the upper gastrointestinal tract revealed a large foreign body occupying the entire stomach, with a superimposed penetrating ulcer at the midportion of the lesser curvature. A gastrostomy and ligation of the ulcer bed was performed, and a large trichobezoar (542 gm.) was delivered from the stomach. Two years later, upon admission to the hospital for pneumonia, the patient was found to have a severe hypochromic anemia and an abdominal tumor. Severe hematemesis associated with melena occurred. At autopsy, a 250-gm. trichobezoar soaked with blood was found in the stomach; 4 additional gastric ulcers were adherent to the adjacent viscera and to the diaphragm.

Gastric ulceration is seen in approximately 10 per cent of patients with trichobezoar, with perforation in 33 per cent of these. This complication has been followed by death due to severe peritonitis in all the reported cases. While it is important for the radiologist to establish the diagnosis of gastric bezoar, it is even more important, as far as immediate care is concerned, for him to attempt to localize possible ulcerations. In four-fifths of the cases, the ulcer is located at the lesser curvature, and the radiographic (as well as pathologic) appearance is that of peptic ulceration.

One roentgenogram; 1 photograph.

Pathogenesis and Roentgen Manifestations of Gastroduodenal Intussusception. G. F. Testa and G. De Micheli. Radiol. med., Milan **45:** 705–725, August 1959. (In Italian) (Istituti Ospitalieri di Cremona, Italy)

Prolapse is the displacement of mucosa (partial prolapse) or of a segment of visceral wall (complete prolapse), either within the viscus itself (as ileo-ileal), into a neighboring viscus (as gastroduodenal), or toward the outside of a natural orifice (as anorectal). A complete prolapse, involving an entire circular segment of wall, is also called invagination or intussusception. When the prolapse can no longer be reduced, it is said to be incarcerated.

In gastroduodenal intussusception, the intussuscepting "head" is the more or less dilated pylorus, while the duodenum provides the "neck." The mechanics and roentgen appearances of the movable negative filling defect are discussed, and 3 illustrative cases are reported. The first was a "small" type of intussusception, proved to be due to adenomatous gastric polypi. The report of the second patient, who had a "large" type of intussusception, includes a detailed fluoroscopic description of the prolapse of a long antral polyp (at its maximum, it reached almost to the third portion of the duodenum), with spontaneous reduction and recurrence; the surgical removal of an allegedly pure fibroma was curative. In the third case the condition was assumed to have been caused by adhesions, and was labeled pseudointussusception.

Fifteen roentgenograms; 2 photographs; 9 diagrams.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Gastro-Intestinal Involvement in Chagas' Disease. Luis Carlos Fonseca. Rev. brasil. de radiol. **2:** 132–134, July-December 1959. (In Portuguese) (Hosp. das Clinicas, Faculdade de medicina, São Paulo, Brasil)

The author was assigned to cover the clinical aspects of a governmental investigation of trypanosomiasis (Chagas' disease) in the interior of the state of São Paulo (Brazil). This preliminary note considers disturbances in the esophagus, colon, and biliary tract.

Megaesophagus in the adult is apparently a late stage, preceded at a younger age by functional disturbances. The two stages can be differentiated by roentgen examination before and after the administration of spasmolytic drugs. Permanent stenosis of the cardio-esophageal junction is the end-stage. After corroboration with cineroentgenographic studies following a barium swallow, a fluorographic procedure has been developed (called Abreugraphy, to honor Manoel de Abreu). This will permit a survey of larger segments of the population in endemic areas.

Megacolon is likewise preceded by functional disturbances, and before-and-after intramuscular injections of Pitressin will separate the "functional" from the "organic" phase. Only tentative statements are made regarding the biliary tract, but it seems that a similar hypotonicity and hypomotility occur in the gallbladder and biliary ducts of patients with Chagas' disease.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Roentgen Appearance of Malignant Tumor in the Duodenal Bulb. G. Piazza and M. Ongaro. Ann. radiol. diag. **32:** 229–242, 1959. (In Italian) (Istituto di radiologia dell'Università di Padova, Italy)

Three case histories are given. The *first* is that of a fifty-six-year-old male with a large, irregular central niche in the duodenal bulb and nodular opacities in the left lower lung field. Autopsy revealed adenocarcinoma of the juxtapyloric duodenum, with metastases to lung, adrenals, and lumbar lymph nodes.

The *second* patient was a seventy-two-year-old man with a dyspeptic history of several months. A barium-meal examination, performed elsewhere, was said to have shown a bulbar niche. Jaundice developed and a second barium meal study disclosed two small filling defects in the bulb. Surgical exploration showed tumor masses in the duodenum and head and body of the pancreas, involvement of the biliary ducts, and large, palpable hepatic nodules.

The *third* patient, a sixty-year-old male, was admitted with what seemed to be an "acute abdomen." A barium-meal examination showed a duodenal mass. At operation the duodenum was found to be infiltrated, and a gastro-entero-anastomosis was performed.

[In the absence of histologic identification in the last two instances, which are also far from fulfilling other criteria for classification as primary neoplasms, only the first case seems to be a *bona fide* primary adenocarcinoma of the duodenal bulb, an exceedingly rare occurrence.—E. R. N. G.]

Ten roentgenograms. E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Duodenal Ulcer in Children; 3 Cases. B. Brunelli and A. Santino. Ann. radiol. diag. **32:** 219–228, 1959. (In Italian) (Istituto di radiologia e terapia fisica dell'Università di Modena, Italy)

In the course of eighteen months, the authors demonstrated duodenal ulceration in a total of 324 patients. Of these, 3 (about 1.1 per cent) were children—a girl of eleven years and boys of eleven and thirteen. The cases are briefly reported and illustrated. The condition is apparently more often present in childhood than is generally assumed.

Twelve roentgenograms. E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Preparation of the Colon for Radiological Investigation Using a New Laxative. Josse Kaye. M. Proc. (Mediese Bydraes) **5:** 458–463, Oct. 31, 1959. (Johannesburg General Hospital, Johannesburg, Union of South Africa)

The cathartic Dulcolax was evaluated as a colonic cleansing agent in 150 patients undergoing abdominal radiological examination. This agent, chemically (4,4 diacetoxy-diphenyl)-(pyridil-2)-methane, is said not to be absorbed from the intestine, to be of low toxicity, and to stimulate colonic peristalsis only upon direct contact with the mucosa. It is supplied in enteric-coated 5- or 10-mg. tablets and 10-mg. suppositories.

Fifty patients (Series I) received Dulcolax, 5–15 mg., the evening preceding the examination, plus an optional suppository on arising; 25 (Series III) received 10 or 15 mg. in tablet form in the evening, plus a mandatory morning suppository; 75 (Series IV) received 5–15 mg. preceded by a suppository, with a second suppository on arising. A control group of 50 additional patients (Series II) was prepared by dietary control, enemas, and castor oil or cascara.

Abdominal roentgenograms, made in all patients before and after preparation, were graded subjectively for evidence of colonic cleansing. "Very good" or "good" cleansing was noted in 64 per cent of Series I, 30 per cent of Series II (control), and in 68 per cent each of Series III and IV. The respective failure rates ("poor" result) were 16, 30, 8, and 15 per cent. Abdominal cramping (13 cases) and excessive stool action (16 cases) were the only side-effects observed, occurring chiefly in patients receiving two suppositories. No evidence of increased colonic irritability was observed at the barium-enema study.

Although stating that 15 per cent of patients were re-examined for failure to follow the dosage schedule, and that "a more accurate assessment" is needed, the authors conclude that Dulcolax is more effective in preparing the colon than the methods used in the control series. They have adopted as a program of colonic preparation the administration of 3 Dulcolax tablets (strength not stated) at bedtime, plus a suppository on arising. The routine is modified in the presence of constipation or diarrhea.

Four roentgenograms; 4 tables.

PHILIP M. JOHNSON, M.D.
Montclair, N. J.

The Use of Water-Soluble Urographic Contrast Media in Paediatric Gastrointestinal Studies. Carroll Z. Berman and Norman L. Avnet. Brit. J. Radiol. **33:** 92–97, February 1960. (Boston Floating Hospital, Boston, Mass.)

A clinical trial is reported of the use of water-soluble organic iodide compounds as gastrointestinal contrast media in examination of infants and children.

These preparations are nontoxic and are presumed less likely than barium to be harmful when aspirated.

They provide good visualization of the gross organ contours in routine upper gastrointestinal studies, but barium sulfate appears superior in problems involving localized mucosal irregularities.

A relatively high incidence of blood-stream absorption and urinary tract opacification was noted, but no instance of systemic reaction to the medium has been observed to date.

The incidence of serious reaction to iodine-containing contrast media in this age group, as recorded in the literature, is extremely low. However, at least one fatality has been reported (Davis: Radiology **71:** 19, 1958) and this consideration must be weighed against any advantages of these substances. Because of this, and on the basis of the authors' experience, the routine use of water-soluble iodine compounds for gastrointestinal study in infants is not recommended. Rather, it appears justified to reserve these preparations for special problems such as intestinal ileus and for infants who are vomiting, where there is significant risk of aspiration.

Fourteen roentgenograms.

THEODORE E. KEATS, M.D.
University of Missouri

Acute Pneumocholecystitis. Z. V. Skokan. Radiol. clin. **29:** 22–27, January 1960. (A. Letenské 6, Prague 12, Czechoslovakia)

The 39 previously reported cases of acute pneumocholecystitis (cholecystitis emphysematosa) proved by roentgenography are reviewed, and a further example is presented.

Acute pneumocholecystitis is a rare inflammation of the gallbladder, caused by gas-forming bacteria. Gas is present in the lumen of the gallbladder and less commonly in the biliary tree. It must be differentiated from gas which has entered through a fistulous communication with some portions of the gastrointestinal tract or as a result of incompetence of the sphincter of Oddi. Gas may also be observed in the wall of the gallbladder, the amount depending on the time which has elapsed between the appearance of the first symptoms and the administration of antibiotics.

The following criteria for the diagnosis of acute pneumocholecystitis are listed:

1. Presence of gas in the lumen of the gallbladder and gas infiltration of its wall.
2. Typical clinical symptoms of acute cholecystitis.
3. Exclusion of pathological communication of the gallbladder and biliary tree with the digestive tract.

Three roentgenograms.

CHARLES M. NICE, JR., M.D., PH.D.
Tulane University

Biloptin: A New Oral Contrast Medium for Cholecystography. Report of Preliminary Trial. C. G. Whiteside. Brit. J. Radiol. **33:** 124–126, February 1960. (Middlesex Hospital, London, W. 1, England)

The author reports a trial of Biloptin (Schering A. G., Berlin), a new cholecystographic medium (iodine content 61.4 per cent) in 60 cases, 36 of which were radiologically normal and 24 abnormal. In all but 1 of the 36 normal cases the gallbladder shadow was well visualized. The gallbladder failed to fill in 5 of the 24 abnormal cases; in these 5 cases the common duct was seen to be normal, and the failure was attributed to obstruction of the cystic duct. Fifteen of the remaining 19 gallbladders filled well and 4 poorly. Stones were present in 17 of the 19 and a chronic cholecystitis with Rokitansky-Aschoff sinuses was demonstrated in another; one examination was inconclusive. In 27 of the 60 cases, the common duct was well or fairly well visualized; it was seen rather poorly in 25 and not at all in 8. These figures refer to the duct before the gallbladder contracted.

In 8 cases in this series cholecystography with Telepaque had been unsuccessful. Studies were repeated with Biloptin after an interval ranging from a day to about four weeks. In 4 of the 8 cases the gallbladder filled with Biloptin and stones were visible. In the remaining 4, Biloptin failed to demonstrate the gallbladder but revealed a normal common bile duct. Examination with Biligrafin in 2 of these also showed a normal bile duct but no filling of the gallbladder.

Biloptin is considered a safe and reliable oral medium for demonstrating the gallbladder, comparing favorably with other media. It has the peculiar advantage that, being concentrated sufficiently by the liver to be visible in the common bile duct, it will, like Biligrafin, fill the nonconcentrating gallbladder, provided the cystic duct is patent. The incidence of nonopacifying gallbladders will therefore be lower with this medium and, if the common duct is clearly seen, re-examination of such cases with Biligrafin will usually be unnecessary. Such gallbladders are unlikely to fill with Biligrafin and are therefore pathological.

The medium is well tolerated by patients and leaves no appreciable residue in the colon.

Tomography in Intravenous Cholangiography. J. A. B. Jones, D. J. Manton, and E. J. Pick. Brit. J. Radiol. **33:** 110–118, February 1960. (St. Peter's Hospital, Chertsey, England)

The authors report a series of 48 consecutive intravenous cholangiographic examinations with tomography. The contrast agent used was Biligrafin Forte. A plain radiograph was made twenty-five minutes after injection of the medium and viewed wet. If it showed even slight filling of the ducts, tomograms were taken. If no excretion was seen, a further plain film was obtained at forty-five minutes and immediately followed by tomograms. Only if the ducts were not visible in these films were further plain radiographs taken at sixty, ninety, and one hundred minutes.

If no contrast medium could be seen in the bowel, a fatty meal was given. In the postcholecystectomy patient, this was administered as soon as the ducts had been demonstrated. All other patients received a fatty meal after the full gallbladder had been examined at two and a half hours. A film was exposed thirty minutes after the meal. If there was still doubt about the passage of contrast medium into the duodenum, the plain film was supplemented by one or two tomograms, the level of these being known from the earlier part of the examination.

All of the films were taken with the patient lying prone, with the right hip and shoulder raised 15 to 20°, to project the common bile duct clear of the spine. Four tomographic cuts were taken at 1-cm. intervals: from 8 to 11 cm. above the table top for patients of average stature, 9 to 12 cm. for large patients, and 7 to 10 cm. for thin ones.

The most frequently encountered causes of difficulty in interpretation are: (1) poor concentration of contrast medium in the ducts, (2) masking of the ducts by overlying bowel contents and gas, (3) spurious

images of calculi produced by bowel contents, (4) confusion caused by contrast medium in the right renal pelvis and ureter, and less frequently in the duodenum and gastric antrum, and (5) failure to demonstrate contrast medium in the bowel. The authors have found tomography helpful in all these difficulties. Tomography improves the contrast; a duct may be seen when little or nothing is visible on the plain films.

The authors conclude that facilities for tomography should be available whenever intravenous cholangiography is performed. Tomograms should be taken unless the major bile ducts are clearly shown to be normal on the first plain film.

Ten roentgenograms; 3 tables.

THEODORE E. KEATS, M.D.
University of Missouri

HERNIA

Hiatal Hernia: Roentgen Incidence and Diagnosis. George N. Stein and Arthur Finkelstein. Am. J. Digest. Dis. **5:** 77–87, February 1960. (Graduate Hospital, University of Pennsylvania, Philadelphia 46, Penna.)

In 100 consecutive roentgen examinations of the upper gastrointestinal tract in adults from twenty to eighty-five years of age, a diagnosis of hiatal hernia was made in 50. Although more common in patients over forty, hernias were found in 34.7 per cent of patients under that age. The high incidence in this series is attributed in part to the technic of examination and in part to the rather broad definition of the term "hiatal hernia."

For complete study of the cardioesophageal junction for hiatus hernia, the authors rely primarily on film study. Three points are emphasized:

1. *The patient must be in the recumbent position.* Examination is carried out with the patient prone-oblique, with the left knee and hip flexed so that the side of the body is elevated between 10 and 30°, and the head turned to the left. This is the right anterior oblique position for Bucky films exposed with the tube over the table, or left posterior oblique for spot-filming with the fluoroscopic tube.

2. *The examination must be made while the patient is swallowing the contrast material.* The fluoroscopist notes how long a lapse occurs between initiation of the swallowing act and the arrival of the bolus in the critical area. The barium mixture is swallowed immediately prior to radiography, and films are taken at such time intervals as were established by preliminary fluoroscopy. Occasionally it is necessary to have the patient swallow the contrast material continually while exposures are being made, to be certain that barium is at the cardioesophageal junction at the proper time.

3. *The examination must consist of multiple exposures of the cardioesophageal region in various phases of respiration.* For this purpose a serialogram, which permits 4 Bucky exposures on one 10 × 12-in. film, is generally employed. After the patient has swallowed the barium mixture, the first and third exposures are made in deep inspiration to take advantage of the closing mechanism of the lower esophagus; the alternate exposures are made during cessation of respiration about midway between normal inspiration and expiration. Routine examination consists of at least two sets of such serialographic exposures (8 in all), sometimes supplemented by spot-films of the cardioesophageal junction when the usual films fail to demonstrate this area adequately.

The controversial criteria for diagnosing the smaller hiatal hernia led the authors to divide them into three degrees: (1) The first degree consists of herniations of the gastroesophageal vestibule alone. Not all observers agree in classifying this configuration as a true hernia. (2) Second-degree hernias consist of those of the gastroesophageal vestibule plus approximately 2 to 3 cm. of the cardiac end of the stomach. (3) In hernias of the third degree, at least 4 or 5 cm. of the cardiac end of the stomach lie above the diaphragm. In the present series, 26 hernias were of the first degree, 21 of second degree, and 3 of third degree.

The authors consider hiatal hernias clinically significant only in so far as they can be related to the patient's symptoms.

Twenty roentgenograms; 1 diagram; 2 tables.

[In an editorial in the same issue of the American Journal of Digestive Diseases (pp. 168–173), Dr. Bernard S. Wolf discusses the definition of a sliding hiatal hernia, from a radiologist's point of view.]

THE MUSCULOSKELETAL SYSTEM

Microroentgenographic Study of Paget's Disease. C. Dazzi and M. Garcia. Ann. radiol. diag. **32:** 98–129, 1959. (In Italian) (Istituto di radiologia dell'Università di Parma, Italy)

The authors report 6 cases of Paget's disease (osteitis deformans), with biochemical, roentgen, histologic, and microroentgenographic findings.

No changes in blood calcium or phosphorus were found in these cases but in the presence of strong osteoblastic activity, there was an increase in alkaline phosphatase. The fact that the latter is increased also in mixed forms showing both sclerosis and osteoporosis is taken as an indication that sclerosis in particular, and Paget's disease in general, must be the result of vascular stasis.

The characteristic roentgen finding is hypertrophic atrophy (Schinz), *i.e.*, enlarged but decalcified bones with diminished structural resistance, leading to bowing in long bones and to crushing in small bones.

The histologic appearance resembles a mosaic, showing predominantly osteoclastic activity in the early stages (osteoporosis), with destruction of haversian canals. Re-ossification, in the later stages, changes the aspect of the cortex from compact to spongy bone, and the bone-marrow to fibrous tissue.

Microroentgenographic studies of sections of healthy and diseased bone, enlarged ×25 to 50, confirm the existence of the histologic changes, especially altered trabeculae and haversian systems. Also well shown is the "tumultous regeneration" phase.

While their observations are not regarded as sufficiently numerous to constitute irrefutable proof, the authors believe that vascular alterations (stasis!) are the actual cause of Paget's disease.

Twenty-four microroentgenograms; 17 roentgenograms; 14 photomicrographs.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Magnified Roentgenography in Rheumatology. José Vitor Rosa. Rev. brasil. de radiol. **2:** 83–85, June 1959. (In Portuguese)

With a fine focus tube (0.3 mm.) and increased object-

cassette distance (over 50 cm.), one may obtain satisfactory "enlarged" roentgenograms. The author considers the procedure to be useful in the study of osseous texture, as in the evaluation of rheumatoid changes in trabeculation.

Five roentgenograms. E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Intertransverse Processes of the Spine. Giuseppe Pedoja. Radiol. med., Milan **45:** 634–639, July 1959. (In Italian) (Istituto di radiologia dell'Ospedale S. Anna, Como, Italy)

Bony bridges, interjoined with pseudarthroses, may unite transverse spinous processes, found thus far only in the lumbar segments. Three such instances are illustrated. Their origin is assumedly congenital (developmental), and a traumatic history, when given, is simply coincidental. The medicolegal significance of this rare finding is obvious.

Four roentgenograms; 3 diagrams.
E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Venography in Fractures of the Femoral Neck. Sven Dahlgren. Acta chir. scandinav. **117:** 494–500, 1959. (Centrallasarettet, Falun, Sweden)

During the period October 1956 to July 1958, intraosseous venography was performed in 72 patients with medial fractures of the femoral neck. About half of these patients were operated upon within three days of injury; the rest were treated by skeletal traction, with operation not earlier than the fourth day. The method of venography employed was that described by Hulth (J. Bone & Joint Surg. **40-A:** 844, 1958. Abst. in Radiology **73:** 146, 1959). In 22 cases examination was unsuccessful. The remaining 50 venograms were classified as follows: 22 positive (contrast-filled veins coming from the femoral head); 14 negative (contrast medium retained in the head and no veins visualized; 3 atypical positive (veins seen though it could not be determined whether or not they came from the head); 11 uncertain negative (contrast medium running out into fracture space and no veins seen).

Leakage of contrast medium into the fracture occurred in 8 of the 26 cases in which operation was done during the first three days following injury, but in only 3 of the 24 cases in which surgery was postponed until after the third day. Two important technical details are stressed: (1) The patient should be nursed in extension for three days prior to the procedure, as otherwise the contrast material may easily leak into the fracture at the time of examination. (2) The obturator foramen must be included in the roentgenogram so that a contrast-filled obturator vein can be seen.

Follow-up examination was carried out in 25 patients in whom venography had been technically successful. All those patients who did not show contrast-filled vessels leaving the femoral head at the time of the first examination subsequently exhibited necrosis of the femoral head. Necrosis also developed in 1 case out of 9 with contrast-filled vessels. The author concludes that venography carried out at the time the fracture is nailed is of value in assessing the prognosis of fractures of the femoral neck.

Two roentgenograms; 5 tables.

THE GENITOURINARY SYSTEM

Sponge Kidney (Observations in 9 Cases). Luigi Vespignani. Ann. radiol. diag. **31:** 276–302, 1958. (In Italian) (Istituto di radiologia degli Ospedali civili riuniti, Venezia, Italy)

Until 1957, the literature contained about 60 cases of "medullary sponge" kidney. Nine examples are here presented.

Sponge kidney is a congenital cystic malformation of the renal pyramids, differing from polycystic kidney by the presence of caliectasis without obstruction. The typical case is bilateral and the patient is usually an adult male. Sponge kidney is in itself asymptomatic, but its complications may cause severe disturbances, such as infection, calculosis, and hematuria.

Urography shows kidneys of unchanged size or shape. Calculi are quite frequently found; they are usually small and of pyramidal distribution (calculus clusters), which is quite suggestive. The typical appearance is the peculiar "spongy" pattern of the renal parenchyma around the pyramids, due to stagnation of iodinated urine in dilated tubules and in minute cavities within the kidney medulla. Differentiation from tuberculosis (which is seldom as extensive), pyonephrosis, and necrotizing papillitis, may be necessary.

Sponge kidney is probably more frequent than heretofore believed, and it is expected that it will be more often recognized in the future. Its complications must be treated, but the condition itself should be managed as conservatively as possible.

Twenty-four roentgenograms; 1 table.
E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Radiographic Evaluation of the Urinary Tract Following Urinary Diversion to an Ileal Bladder. James R. Jude, Lee B. Lusted, and Robert R. Smith. Cancer **12:** 1134–1141, November-December 1959. (J. R. J., Johns Hopkins Hospital, Baltimore 5, Md.)

From July 1956 to January 1958, urinary diversion to an ileal bladder was performed in 22 patients at the National Cancer Institute (Bethesda, Md.) The authors present a method for the radiological evaluation of the urinary tract in patients who have undergone such an operation.

All of the patients in the series had preoperative excretory urograms and postoperative serial studies. Fifteen patients also had postoperative retrograde urinary ileograms. Excretory urography was performed in the usual manner, with Hypaque Sodium as the contrast medium. For the retrograde urinary ileograms the medium was injected through a 5-c.c. Foley balloon catheter in the stoma of the urinary ileostomy. The contrast agent was dilute Hypaque Sodium solution (30 c.c. of 50 per cent Hypaque Sodium added to 100 c.c. of sterile distilled water containing 1 gm. of neomycin sulfate). Sterile barium enema equipment was used to introduce the solution under fluoroscopic control into the ileal bladder. If ureteral reflux occurred, it was seen before the ileal bladder was distended, and filling was discontinued. If no reflux was observed, the ileal bladder was filled to maximum capacity and the Foley catheter temporarily clamped. Three anteroposterior radiographs were taken to demonstrate the full and empty ileal bladder—one with the patient supine with the ileal bladder filled and the Foley catheter clamped; another with the

patient erect with the Foley catheter removed and the ileal bladder empty; the third with the patient erect after fifteen minutes of emptying to demonstrate any bladder or ureteral retention.

The retrograde studies showed that the ileal bladder filled readily in all 15 patients and revealed no abnormality. In 9 patients bilateral ureteral regurgitation occurred; in 4 there was unilateral regurgitation, and in the remaining 2 no ureteral filling. The only complication encountered was a transitory episode of acute pyelonephritis immediately after the retrograde examination in 1 patient.

In the authors' experience, late postoperative intravenous pyelograms almost invariably showed a return to normal if the disease for which the substitute bladder was constructed remained under control, *i.e.* recurrent cancer did not develop. In the 22 patients studied, the number of renal units that had a normal intravenous pyelogram increased from a preoperative level of 55 per cent to 75.4 per cent in the six-to-twenty-four-month postoperative follow-up period. An additional 9 per cent had only minimal hydronephrosis at the time of the later follow-up. In two-thirds of the renal units exhibiting no function on preoperative pyelographic studies, there was a significant return of function after the ureter was placed in an ileal bladder.

The most important information to be obtained from the retrograde study of the ileal bladder is the status of the ureteroileal anastomosis. When hydronephrosis persists or develops during the postoperative period, the surgeon is interested in early confirmation of the degree of patency of the anastomosis. In this situation a retrograde urinary ileogram together with an excretory study may be of exceptional value. When the intravenous pyelogram is normal, a retrograde study adds little to the immediate clinical evaluation of the patient.

Five case histories illustrate the information that may be obtained from the radiographic studies.

Twenty-nine roentgenograms; 2 tables.

Aortography in Nephrolithiasis. G. Collo and F. Favero. Ann. radiol. diag. **32:** 155–167, 1959. (In Italian) (Istituto di radiologia dell'Università di Bologna, Italy)

The authors have performed over 350 aortographic investigations for various reasons. In the 3 cases reported here renal calculi were present, and the examination was of help in determining whether or not the involved kidney (or the opposite one) functioned properly, which is of obvious importance when surgical decisions have to be made. Indeed, it is argued that bilateral nephrolithiasis in itself constitutes an indication for aortography, because of the need for functional evaluation.

Nine roentgenograms. E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Diagnostic Value of Pneumo-Uretero-Pyelography in Nephro-Uretero-Lithiasis. A. Caffaratti and A. Morelli. Ann. radiol. diag. **31:** 423-440, 1958. (In Italian) (Istituto di radiologia dell'Università di Torino, Italy)

During cystoscopy with ureteral intubation, from 7 to 20 c.c. of atmospheric air can easily be instilled with a syringe into the ureter. The authors have used this procedure in about 120 cases, with no demonstrable side-effects except transient discomfort due to distention of the kidney pelvis.

Ureteral air insufflation can be employed as a negative or as a double-contrast procedure. Seven case histories illustrate its value—when corroborated by conventional intravenous and retrograde pyelography—in outlining calculi, otherwise not (or less easily) detectable.

Twenty-six roentgenograms; 4 diagrams.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Retrograde Pyelography and Use of Contrast Mediums Containing Neomycin. Howard A. Hoffman and Miguel Paes de Carvalho. J. A. M. A. **172:** 236, Jan. 16, 1960. (60 Eighth St., New Bedford, Mass.)

It is felt by the authors that the reactions secondary to retrograde pyelography are mainly due to overdistention of the renal pelvis during injection of the radiopaque medium. This is believed to be true of both the immediate sensation of pain and the delayed reaction characterized by bacteremic chills and fever. In the absence of hydronephrosis or pyelectasis the average adult renal pelvis is not prepared to accept more than 3 c.c. of the contrast material. In children 2 c.c. should be maximal, and in infants 1 c.c.

Two consecutive series of 100 patients each were studied: one in which a simple contrast medium (methiodal sodium) was used and one in which 2.5 per cent of neomycin was added to determine the effect on the incidence of the delayed bacteremic reactions. These reactions were noted in 2 patients in each group. The diagnostic quality of the films was identical in the two series.

The conclusion is that "the prophylactic or therapeutic value of the addition of neomycin sulfate to opaque media seems insufficient to justify its use at an increased cost." Care to keep within the anatomic capacity of the renal pelvis is of greater importance.

R. LYNN TURNER, M.D.
Indiana University Medical Center

Di-Iodinated or Tri-Iodinated Urographic Contrast Media? Further Research on the Mechanism of Renal Elimination of the Contrast Media for Urography. M. Piemonte and L. Magno. Radiol. med, Milan **45:** 744–785, August 1959. (In Italian) (Istituto di radiologia dell'Università di Milano, Italy)

In 64 intravenous urographic examinations performed on 47 patients, the authors found no detectable difference between di-iodinated and tri-iodinated contrast media. Nor does the condition of the renal parenchyma (for instance severe deterioration) seem to determine the quality of the urogram. Indeed, there appears to be no demonstrable relationship between the quantity of iodine eliminated during the examination and the degree of urinary opacification. There is, conversely, a very direct proportionality between the volume of eliminated urine and the density of the pyelocalyceal image. Consequently, the water balance of the body and the anatomophysiologic integrity of the urinary channels are the decisive factors in producing satisfactory visualization.

Nine diagrams; 7 tables.

E. R. N. GRIGG, M. D.
Cook County Hospital, Chicago

The Radioactive Hypaque Renogram. Assessment of Renal Function with Automatic External Scintillation Detection Equipment. Torsten Denneberg and Inge Hedenskog. Acta med. scandinav. **165:** 61–70, 1959. (Malmö General Hospital, Malmö, Sweden)

An investigation was made of the value of renograms with I^{131}-labeled Hypaque in 125 patients with various renal diseases such as glomerulonephritis, pyelonephritis, nephrosis before and after steroid and chlorothiazide therapy, polycystic kidneys, ureteral obstruction, and hydronephrosis. All the patients except those examined in the acute stage of the disease were studied in the post-absorptive state. With the patient sitting a shielded scintillation detector head with a "I by I" thallium-activated sodium iodide crystal was placed over the chest and two over the kidneys. The tracer dose consisted of 0.2–8 mg. of Hypaque, which was injected intravenously. This dose corresponds to about 25 μc of I^{131}.

It was found that in renograms obtained with Hypaque, in contrast to Diodrast renograms, the shape of the tracing was not influenced by radioactivity from the hepatobiliary ducts. Good agreement was obtained between the renograms and the results of other function tests. It is therefore concluded that the Hypaque renogram is of value as an additional means of determining kidney function. It is particularly useful in the investigation of patients in whom excretory urography is inadvisable owing to increased nonprotein nitrogen.

Five figures.

TECHNIC—CONTRAST MEDIA

Factors Influencing Image Quality in Cineroentgenography. J. A. Campbell, E. C. Klatte, and R.A. Shalkowski. Am. J. Roentgenol. **83:** 345–353, February 1960. (Indiana University Medical Center, Indianapolis, Ind.)

Good image quality is a necessary prerequisite to effective cineroentgenography. The authors discuss in well illustrated detail the factors which contribute to this.

1. *Image Tube Scintillation:* One of the most frequent causes of poor cine-image quality is the excessive scintillation of a high brightness gain image tube at low radiation inputs. It may be necessary to use slower film or decrease the speed of the lens to obtain satisfactory results.

2. *Image Tube Focus:* Since an image amplifier functions in a manner similar to intensifying screens, there is some loss in resolution. Poor electrostatic focus of the image tube may affect resolution, and since this is dependent on the voltage applied across the electrodes, it should be frequently adjusted.

3. *Focal Spot Size and Magnification:* Since the fluoroscopic table height limits the target-object distance, the magnification factor may contribute some geometric unsharpness to the image. The use of a fractional millimeter focal spot will tend to offset this unsharpness to some extent. Increasing the target-table top distance will also improve the resolution, but this imposes a heat load on the anode which cannot be tolerated by the fractional focal spot. A 1.0-mm. focal spot unit offers the best compromise between image quality and heat capacity.

4. *Camera Focus:* A frequent source of poor cine-image quality is a faulty optical system. There are two lenses in this system. The first stage lens is fixed in position and cannot be adjusted by the radiologist. The second stage lens is focused on the cinefilm and must be kept in sharp adjustment.

5. *Vignetting Effect of Optical System:* A vignetting effect occurs when there is a light loss at the edges of the lens causing the film to receive less exposure in the peripheral zone than in the center. Severe vignetting may result in the loss of as much as a third of the film image at the periphery of the field. The reduction of vignetting to tolerable limits requires the substitution of a lens system providing a different combination of focal lengths and diameters or one of better optical quality.

6. *Choice of Cinefilm:* It is necessary to employ a film which is a good compromise between speed, contrast, and grain size. Most of the authors' clinical experience has been with Linagraph Shellburst film, which has excellent contrast, moderate speed, and moderate grain size.

7. *Film Size:* The authors prefer 16-mm. film because 35-mm. film does not offer sufficient clinical advantages to offset increased cost, higher radiation doses, and greater handling problems.

8. *Kilovoltage and Grids:* While high kilovoltage is useful in reducing radiation dose, especially in the study of thick parts, this may be accompanied by a critical loss of image contrast. To achieve more satisfactory image quality, it is frequently better to use lower kilovoltage and high contrast cinefilm emulsions, even though this necessitates some increase in radiation dose. Contrast may be also enhanced by use of grids, although this also involves increased radiation.

9. *Film Processing:* An ideal developing solution should enhance the contrast and bring out the ultimate speed of the film emulsion. X-ray developer is best suited for this purpose, since it increases film speed two to three times as compared to fine grain developers, and the contrast is improved.

10. *Exposure Time:* The exposure time for each cineframe should be sufficiently short to reduce the motion unsharpness to a minimum because of the large magnification factors involved in recording and projecting the images. This can be accomplished with exposure times of 1/60 to 1/120 second for respiratory and intestinal motions. By use of appropriate timing devices and film travel speeds, exposure times of 1/120 second may be obtained that are adequate for cardiac studies and other fast tissue motion.

The authors conclude that adequate image quality for clinical diagnosis may be obtained with reasonable radiation dosage (0.6 to 26 r per minute) from 16-mm., image-intensified cineroentgenography.

The interested reader is urged to study in the original this well illustrated and detailed article.

Two roentgenograms; 6 photographs; 4 tables.

JOHN P. FOTOPOULOS, M.D.
Northwestern University Medical School

Speculation on the Value of the Right or Left Indicator on the Radiograph. Morris Owen. Proc. Coll. Radiologists Australasia **3:** 101, December 1959. (Royal Newcastle Hospital, Newcastle, N. S. W., Australia)

The author states his distrust of the right and left indicator on the radiograph and cites cases where costly mistakes in diagnosis can be made from errors in markings. The radiologist must check the film marking in

each case. This can be done by recognition of the tube side of the film, coupled with a knowledge of the position of the part during examination. Correlation must then be made with normal anatomical structures. Because of possible errors in marking, time involved in verification of the indicator, and its general lack of value, the author is of the opinion that use of the right and left marker on radiographs should be discontinued.

CAPT. ALLAN E. GREEN, JR., M. C.
Lackland AFB, Texas

The Use of Contrast Media in the Investigation of the Acute Abdomen. Eric Samuel. Brit. J. Radiol. **33:** 82–91, February 1960. (Royal Infirmary, Edinburgh, Scotland)

The uses of contrast media in various acute abdominal conditions are discussed. The value of water-soluble oral preparations in investigating bleeding from the gastrointestinal canal is pointed out. The author uses Gastrografin for this purpose, combined with the "no-touch" technic. The entire examination is undertaken with the patient in the supine position with dependence upon gravity to place the bolus of medium in the area of interest. A surprising finding has been the comparative absence of spasm and deformity in many cases of bleeding from a duodenal ulcer.

Leaks and suspected leaks from duodenal ulcers have been investigated by means of water-soluble contrast media. In a series of 8 cases a leak was found in only 1 instance, but a number of examples of penetrating ulcers were noted. Leaks from suture lines postoperatively have also been demonstrated. Water-soluble media have proved useful in locating sites of intestinal obstruction as well as in investigation of the gastrointestinal tract in cases of pancreatitis.

The author uses Biligrafin in the differentiation of acute obstructive and non-obstructive cholecystitis. By this method, an opinion on the patency, or otherwise, of the cystic duct can be obtained. A complete failure of visualization of either the gallbladder or the extrahepatic ducts indicates that the liver has failed to concentrate the medium sufficiently to enable a shadow to be seen and no opinion as to the state of the gallbladder can be expressed.

The liver may readily excrete the medium, demonstrating the extrahepatic biliary passages, the cystic duct, and the gallbladder. This usually indicates a normal biliary system, but it does not wholly exclude the possibility of an acutely inflamed gallbladder. If the extrahepatic ducts fill normally but the gallbladder fails to be visualized even when films of the right hypochondrium are taken up to two hours, obstruction of the cystic duct is indicated. The author points out that in some cases of pancreatitis, non-filling of the gallbladder occurs. No explanation for this finding is apparent.

The value of intravenous urography in investigation of acute urinary conditions is also discussed. In a series of 200 consecutive patients with "acute abdomens" x-rayed in the author's department, 15 had potential renal lesions and in these cases stone formation was seen on plain films in only 20 per cent, indicating the need of intravenous urography. The following features point to the presence of a non-opaque stone: (1) late appearance of the urogram on the affected side; (2) prolonged nephrogram on the affected side; (3) when the pyelogram phase appears, distention of the renal pelvis and ureter as far as the site of obstruction if the case is followed for a sufficiently long period.

Twenty-seven roentgenograms; 3 diagrams; 2 tables.

THEODORE E. KEATS, M.D.
University of Missouri

The Inhibiting Action [Antibacterial] of Joduron B. Zdeňka Ježková and Milan Svoboda. Radiol. clin. **29:** 1–5, January 1960. (In German) (U nemocnice 1, Prague II, Czechoslovakia)

Since the Second World War, water-soluble contrast media have been used more frequently in bronchography. As a test of possible antimicrobial activity, 0.5 ml. of 100 different bacterial suspensions were added to 5.0 ml. of Joduron B. The cultures included several types of Staphylococcus, Streptococcus, Neisseria, C. pseudodiphtheriae, B. coli, B. paracoli, and Pseudomonas.

The medium was shown to have a pronounced antibacterial action, not confined to the contrast component, but also attributable to the viscosifying agent (carboxymethylcellulose) and the preservative.

One table.

CHARLES M. NICE, JR., M.D., Ph.D.
Tulane University

MISCELLANEOUS

Radiological Aspects of Abdominal Abscesses. J. J. Martin. Proc. Coll. Radiologists Australasia **3:** 93–100, December 1959. (Alfred Hospital, Melbourne, Australia)

On roentgenograms of the abdomen an abscess may appear as a homogeneous shadow of approximately soft-tissue density. Among suggestive radiologic signs are: alterations in the movements of the diaphragm; alterations in the outline and mobility of adjacent viscera; postural changes in the spine; obliteration of the psoas outlines; changes in the flank structures and in the pleura and lungs. The most conclusive diagnostic feature, however, is the presence of gas in the abscess cavity, as a collection above a fluid level, a single irregular loculus, a number of loculi, or multiple small gas bubbles. Several cases are reported to illustrate the changes produced in different locations.

Subphrenic abscesses may cause elevation and immobility of the diaphragm. On the left side the stomach may be displaced and on the right the liver may be depressed. Changes have been noted in the lung and pleural cavity above the abscess. In addition there may be an area or areas of consolidation in the adjacent basal pulmonary segments. Gas is present in 25 to 50 per cent of subphrenic abscesses.

An abscess in the *right iliac fossa* may be manifested by displacement of the adjacent bowel and alterations in its mucosal pattern.

There are a number of radiological signs associated with *perinephric abscess*. A case is reported in which scoliosis, obliteration of the psoas outline, and medial bulging of the flank structures were significant observations.

The commonest radiological manifestation of a *pelvic abscess* is a homogeneous opacity in the pelvis, which, however, should not be confused with a distended bladder. The bowel pattern is variable since in some cases there may be an associated paralytic ileus or a bowel obstruction.

In *intraperitoneal abscesses* the distance separating adjacent bowel loops is of diagnostic importance. If there is a fibrinous exudate or free fluid between loops

of bowel, it will widen the distance between two contiguous loops. Occasionally it is possible to see small bubbles of gas between adjacent loops, and this is strong evidence of peritonitis.

Fifteen roentgenograms.

Roentgen Findings in Calcified Dracunculosis. M. Ghigo and M. Magrini. Radiol. med., Milan **45**: 953–963, October 1959. (In Italian) (Istituti ospedalieri di Santa Corona in Pietraligure, Italy)

Dracunculosis is a subcutaneous infestation with the filarial parasite *Dracunculus medinensis*, also called guinea worm. The disease is endemic in equatorial and tropical Africa, as well as in Asia (Persia, Turkestan, India), British Guiana, Brazil, and even in Oceania (Fiji Islands). The intermediate host is a small crustacean of the genus *Cyclops*. Infestation takes place in man by ingestion of the crustacean (unfiltered water!), which is digested in the gastric juice, thus liberating the parasitic larvae. The latter pass through the gastric or duodenal mucosa, reach the lymphatics, and then—because of a delicate affinity—the subcutaneous tissue (usually in the lower extremities). Here the adult female *Dracunculus* is a worm about 2 mm. in diameter and from 20 to 120 cm. in length, which secretes an irritating substance, causing a small skin ulceration. On contact with water, the uterus of the parasite ruptures and the eggs escape through the ulcerated skin to begin a new cycle.

Extraction of the worm is performed by making a small cut into the patient's skin, after which the worm's head is fastened to a slit in a wooden stick. Subsequently, this stick is rotated very slowly and the entire worm may be thus removed in from seven to twenty-three days.

During 1955–57, the senior author, as radiologist in the Royal Hospital Ahmed I in Hodeidah (Yeman), observed a large number of cases of dracunculosis. Eleven such instances are reported in this paper. The worm cannot be demonstrated roentgenographically as long as it is alive (unless injected with contrast material, in which case its intestinal canal is visualized), but after it dies it becomes visible because of deposits of calcium. These deposits are not uniform and they may re-absorb, at least partially, so that there are considerable variations in the picture. Involvement of articulations, especially the knees, is frequent and usually leads to severe damage, sometimes ankylosis.

Actually, when a calcified worm is demonstrated, this means, in the authors' experience, that the organism has won the battle, the parasite has not been able to reach the skin and spill its eggs; it has dried (prematurely) and is now entombed in mineral.

Thirteen roentgenograms. E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Mucormycosis. Orlando F. Gabriele. Am. J. Roentgenol. **83**: 227–235, February 1960. (Hospital of St. Raphael, New Haven, Conn.)

Mucoraceae are common saprophytic fungi which under certain circumstances can produce a rapidly fatal disease. The spores may be air-borne and enter the sinuses and lungs by inhalation. The reported cases of mucormycosis in man have almost invariably been associated with some underlying disease, particularly metabolic disturbances such as diabetes mellitus. Presumably these conditions cause an alteration in susceptibility and response to infection and permit this uncommon disease to develop. Since Mucoraceae are such common laboratory contaminants, diagnosis should be made only if tissue invasion can be demonstrated histologically. Several forms of involvement—cutaneous, ocular, cerebral, pulmonary, gastrointestinal, and disseminated—have been described.

The infection is characterized by acute inflammation and vascular thrombosis caused by invasion of the walls and the lumina of blood vessels by the fungus. Infarcts are characteristic and are demonstrated on films as pulmonary infiltrations. In cerebral mucormycosis thrombosis of the internal carotid artery is common. Other thromboses may involve the ophthalmic vein and artery, retinal artery, and peripheral pulmonary arteries. There is almost always paranasal involvement, manifested by clouding and thickening of the mucoperiosteum on the films.

Four cases are reported in detail.

Five roentgenograms; 2 tables.

MAX EICHWALD, M.D.
Encino, Calif.

Rare Case of Splanchnic Siderosis. G. Carta and F. Pirastu. Ann. radiol. diag. **32**: 60–68, 1959. (In Italian) (Istituto di radiologia medica dell'Università di Cagliari, Italy)

An unusual case of siderosis was observed in a 65-year-old man who had worked in various mines for twenty-nine years, twenty-two of which were spent in the mining of iron ore. There was a history of malaria at the age of nine, with several recurrences.

The presenting symptom was pain, coming on about two hours after each meal. Although this latter complaint had been present for about two years, it had become more severe just before hospitalization.

A chest roentgenogram showed pronounced reticulation, with multiple small nodules in the lung fields. Fibrocalcific residuals in both apices were believed to represent healed infection. The appearance was also suggestive of pulmonary emphysema. Abdominal films demonstrated opacification of both liver and spleen, with many small calcifications in the spleen and in epigastric lymph nodes. The aspect was similar to that found after Thorotrast injection, but there was no history of such a procedure. Laparotomy, with liver biopsy, proved the existence of iron deposits, with "hemosiderotic hepato-lieno-sclerosis."

In the presence of such opacifications as have been described in the liver and spleen, the possibility of exposure to iron ore should be considered.

Three roentgenograms; 2 photomicrographs.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

RADIOTHERAPY

The Place of Grenz Radiation in Dermatologic Practice. Victor H. Witten. Arch. Dermat. **81**: 110–123, January 1960. (999 Fifth Ave., New York 28)

Over the past decade the author and his associate, Dr. Marion B. Sulzberger, have used grenz rays in the treatment of many hundreds of patients with benign dermatologic diseases and many thousands of lesions. In all of this material they have encountered no evi-

dence whatsoever of sequelae other than early evanescent erythema in a few patients and a transient pigmentation in a somewhat larger number. In none of these patients have they seen atrophy, depilation, telangiectasis, signs of reduced activity of sweat or sebaceous glands, ulceration, or the development of premalignant or malignant lesions even after the repeated use of this modality. Some of the patients received total doses of the order of 6,000 r to a single area, fractionated over a three- to five-year period. In European clinics even larger doses of grenz rays have been administered without undesirable sequelae.

Grenz radiation is exclusively the dermatologist's form of therapy—one suited for the treatment of superficial diseases of the skin rather than for the deeper lesions or for diseases of other organs. In order to restore public confidence in ionizing radiation, the dermatologist should be prepared to champion the following advantages of grenz radiation: (1) the factor of safety with regard to the skin and subcutaneous structures, and (2) the factor of safety with regard to irradiation of the gonads.

Since an increasing use of grenz rays may be anticipated, it is important that there be some standardization and uniformity in their application if the fullest therapeutic benefits are to be achieved and the safety factors maintained. In order to do this, it is imperative that: (1) the grenz ray unit be properly calibrated by qualified physicists using instruments specially designed for this purpose; (2) the selection of lesions for grenz-ray therapy be based on a familiarity with the depth-dose curves for radiation of this quality; (3) the few required simple precautions be taken when treating in the gonadal area; (4) the equipment (and shielding) be used properly, and (5) therapy be based on a knowledge of the indications, dosage schedules, and results to be expected from this form of radiation.

Three figures; 5 tables.

The Evolution of a Superficial X-Ray Therapy Technique for Carcinoma of the Skin. R. Kaye Scott. Proc. Coll. Radiologists Australasia **3:** 109–114, December 1959. (Royal Melbourne Hospital, Melbourne, Australia)

The author traces the change in radiation therapy technic for carcinoma of the skin at the Royal Melbourne Hospital from 1930 to 1958, when the present treatment plan was initiated. This employs a superficial x-ray machine, with delivery of eight doses of 500 r each in three weeks. Three treatments are given weekly except in the third week, when the middle dose is omitted. The radiobiologic reasons for this fractionation plan are discussed. Less severe skin reactions and better cosmetic results are obtained than with previous methods. Field size reduction technics are utilized to avoid the formation of sharply demarcated scars. Cure rates appear good although only a six-month follow-up is available.

Four tables. CAPT. ROBERT E. WILDIN, M.C.
Lackland AFB, Texas

Keloids: Etiology, and Management by Excision and Intensive Prophylactic Radiation. Harry L. Arnold, Jr., and Franklin H. Grauer. Arch. Dermat. **80:** 772–776, December 1959. (1020 Kapiolani St., Honolulu, Hawaii)

This report is based on 179 keloids, in 155 patients, treated in a variety of ways. Forty-nine patients were males and 106 females. The only disproportion in sex incidence was that resulting from the many laparotomy scars following gynecologic procedures.

Eight of 17 untreated keloids grew worse, and 4 remained unimproved; there was spontaneous subsidence of the keloid in 2 cases, and in 3 the final result is designated as "fair." Fifteen untreated patients were not followed. Excision alone was successful in only 2 of 14 cases. Eleven cases were treated with hyaluronidase or hydrocortisone injections, or both, or topical applications of hydrocortisone solution or ointment; failures outnumbered successes, 5 to 2 in the 7 cases that could be followed after such treatment.

Irradiation alone was used for 67 keloids, usually inoperable lesions or lesions that had begun to recur after excision. "Good" results (80 to 100 per cent success) fell short of "fair" and "failure" outcomes by a small margin when conservative radiation technics were employed, but exceeded them by 3 to 1 among the 45 lesions given 500 r every five days for two to six doses. Prophylactic irradiation following surgical excision (52 keloids) gave equal numbers of "good" and "fair" or "failure" results when conservative doses were employed, and better than 3 "good" results to 1 "fair" or "failure" when the intensive regimen was used.

The authors believe it is best to excise keloids surgically, close the wound with minimal tension, and start prophylactic irradiation as soon as healing has advanced sufficiently to permit removal of all or most of the sutures. The technical factors preferred are 140 kv; 5 ma; no filter; 25 cm. distance; h.v.l. approximately 2 mm. Al. The skin is shielded right up to the line of the incision—or, occasionally, the area of the early recurrence of keloid—with Wilson's bismuth putty (bismuth subnitrate in anhydrous lanolin), over which is laid a sheet of lead rubber with a 1-cm.-wide opening across its middle. Smaller sheets of lead rubber laid crosswise shield the skin beyond the ends of the incision. The relative generous dose of irradiation, 500 r every five days for two to six doses, is predicated on the fact that the narrow field permits virtually no back-scatter, thus reducing the effective tissue dose to well under an erythema unit. In 69 cases irradiated thus intensively, 61 of which have been followed from one to ten years, only 4 instances of mild telangiectasia were seen.

Five figures; 6 tables.

A Three-Electrode Ionization Condenser Chamber. J. Cederlund. Brit. J. Radiol. **33:** 105–109, February 1960. (Radiofysiska Institutionen, Lund, Sweden)

A special ionization chamber has been described which has three electrodes and two air volumes. The device may be used to measure very small doses where the dose is proportional to a voltage in contrast to a conventional chamber, where the dose is proportional to the difference between two almost equal voltages. Large doses may also be measured. No prior knowledge of the dose expected is required since the measuring range may be selected after the chamber has been irradiated. AUTHOR'S SUMMARY.

RADIOISOTOPES

Diagnosis of Heart and Lung Function with the Aid of Albumin Labeled with I^{131}. H. Hundeshagen, E. H. Graul, E. Betz, W. Kaufmann, J. Schlitter, and H. G. Scholtze. Atompraxis **6:** 15–20, January 1960. (In German) (Medizinische Universitätsklinik, Marburg/Lahn, Germany)

The combination of direct measurements in the arterial blood and indirect measurements of time-concentration curves at three different sites over the heart and lungs after injection into the cubital vein of albumin labeled with I^{131} makes possible a comprehensive evaluation of physiological and pathophysiological hemodynamics. The method was tried in tuberculosis patients and was found particularly useful for determination of the central blood volume. Among other things, the relationship between the average circulation time and the heart time-volume was found to vary with differing stresses. After injection of the radioactive solution through a heart catheter into individual segmental arteries, data can be obtained on the circulatory conditions in each segment.

Ten figures; 1 table.

Treatment of Toxic Nodular Goitre with Radioactive Iodine. B.-A. Lamberg, C. A. Hernberg, P. Wahlberg, and Riitta Hakkila. Acta med. scandinav. **165:** 245–258, 1959. (Maria Hospital, Helsingfors, Finland)

A total of 144 patients with hyperthyroidism, from a region in which mild goiter is endemic, were treated with radioactive iodine. In 12 of these cases the thyroid was not demonstrable, 34 had a diffuse goiter, and 98 nodular goiter. The shortest observation time in the series was five months. In the first two groups, remission of symptoms occurred in 71.8 per cent of the cases, and 21.7 per cent became hypothyroid. In the patients with nodular goiter, the corresponding figures were 81.6 and 8.2 per cent. In 2.8 per cent of the cases the results were still difficult to evaluate at the time they were compiled. In 9 cases (6.3 per cent) the response was characterized as "failing." Two of these patients died, and the others were treated with surgery or antithyroid drugs. In 7 cases (4.9 per cent) there was a severe post-treatment reaction and in 16 (11.1 per cent) transient aggravation of the thyrotoxic condition. Temporary hypothyroidism was diagnosed in 7.7 per cent.

Postoperative relapses of hyperthyroidism appeared to constitute an ideal group for treatment with radioactive iodine. Of 31 such cases, 87.1 per cent were brought into euthyroidism; 9.7 per cent became hypothyroid; in 1 case (3.2 per cent) the response was of the "failing" type. In 27 cases recurrences after long-term use of thyrostatic drugs were treated: 74.1 per cent of this group became euthyroid, 11.1 per cent hypothyroid, and 14.8 per cent showed a "failing" response.

In 3 cases there was a marked increase of the thyro-hypophyseal eye syndrome, and in many cases there was an increase of the eye signs clinically as well as exophthalmometrically. In 1 case, however, there was a gradual marked improvement of the eye condition.

It is felt that in a region where multinodular goiter is endemic the range of indications for radioiodine treatment of nodular goiter with hyperthyroidism will probably be wider than originally supposed. A general scheme is presented showing the different types of treatment related to the nature of the goiter and age.

Two figures; 5 tables.

The Use of a Cobalt 60 Beam Unit for the Treatment of Carcinoma of the Larynx. R. C. Tudway and H. F. Freundlich. Brit. J. Radiol. **33:** 98–104, February 1960. (Bristol Royal Hospital, Bristol, England)

In this paper, the five-year survival rate is presented for all cases of carcinoma of the larynx seen at the Bristol Royal Hospital from 1948 to 1953, before the use of cobalt, and a comparison is made with results in cases seen from 1955 to 1958, after the introduction of cobalt therapy. There were 65 patients in the early group; 25 of these had laryngectomy and the remainder deep x-ray therapy. Of 62 patients treated from 1955 to 1958, 49 had cobalt therapy, 5 laryngectomy, 5 deep x-ray therapy, and 3 palliative medication.

It is assumed that the nature of carcinoma of the larynx did not change from 1948 to 1958 and that the distribution of grades of pathology, clinical types, and stages were not different in the two groups. Prior to the use of cobalt therapy, early tumors were removed surgically, and advanced cases were given radiotherapy. After installation of the cobalt unit, it was used for the treatment of early cases.

For cobalt therapy two anterolateral oblique fields were used, with wedge filters. A dose of about 6,700 rads in six and a half to seven weeks was given to small areas in early cases; with wider fields, in more advanced lesions, the dose was reduced. With 1,000 rads per week, mild skin reactions were observed, and marked but only rarely incapacitating mucosal reactions. A higher dose rate definitely caused more severe effects.

The authors utilized a statistical method (Boag, T. W.: Brit. J. Radiol. **21:** 128 and 189, 1948; J. Roy. Statist. Soc. **11:** 15, 1949 B.) to predict the five-year survival rate in both groups. In the 1948–53 cases, the predicted rate was 36 per cent and the actual survival rate 32 per cent. The discrepancy is due to deaths from intercurrent disease. A predicted survival rate of 53 per cent was obtained in the 1955–58 group. This distinct improvement is thought to be due to the use of the cobalt unit and will be confirmed or disproved in 1963, when the actual five-year survival figures can be evaluated.

Two diagrams; 1 graph; 5 tables.

SAMUEL B. HAVESON, M.D.
Lynwood, Calif.

Absorption of Radioactive B_{12} in Patients with Pernicious Anemia after Long-Term Oral and Parenteral Therapy. P. J. Fouts, O. M. Helmer, and S. M. Chernish. Ann. Int. Med. **52:** 29–43, January 1960. (Lilly Laboratory for Clinical Research, Indianapolis, Ind.)

More than 400 pernicious anemia patients have been treated with oral and parenteral liver extracts, intrinsic factor preparations, and injectable B_{12} solutions in the Hematology Research Clinic, Marion County General Hospital, Indianapolis, Ind. Some of the patients have been on oral therapy for twenty-nine years; others, on intrinsic factor preparations, parenteral liver, or B_{12} solutions for as long as twenty-six to twenty-seven years.

During the last four years, Schilling assays (J. Lab. & Clin. Med. **42:** 860, 1953) were performed on 94 patients in whom a diagnosis of pernicious anemia had been made. This procedure demonstrated that in patients with pernicious anemia vitamin B_{12}-Co^{60}

administered orally in small amounts is not absorbed unless accompanied by a potent source of intrinsic factor such as human gastric juice or desiccated hog gastric tissue. The degree of absorption of the radioactive vitamin B_{12} is indicated by the amount of radioactivity appearing in the urine during the twenty-four hours following ingestion of the radioactive vitamin and the administration subcutaneously of a "flushing" dose of 1,000 micrograms of nonradioactive vitamin B_{12}. Because of recent reports suggesting that a refractory state may develop in some pernicious-anemia patients treated with vitamin B_{12} in combination with intrinsic factor concentrates prepared from hog mucosa, it was thought that the findings in the above group of patients might be of interest, particularly in view of the long-term therapy.

It was found that, in patients with pernicious anemia treated with antianemic preparations containing crude liver-stomach digests, refractoriness to hog intrinsic factor preparations did not develop, as judged by the Schilling assay. A refractory state did develop in 1 of 11 patients treated with a semipurified hog intrinsic factor-B_{12} combination which did not contain liver-stomach digests; this patient responded to human gastric juice. Five other patients treated with this preparation excreted small amounts of radioactive B_{12} in the Schilling test, but, with larger amounts of hog intrinsic factor, this blockage was overcome.

Of the 94 patients in this study who had been treated for pernicious anemia for from one month to thirty years, 9 absorbed vitamin B_{12} normally, as judged by the Schilling technic.

Two patients were found to have malabsorption syndrome. The gastric juice of 1 of these contained normal amounts of intrinsic factor when tested in a patient with pernicious anemia.

The authors believe that the Schilling assay is a valuable tool in the study and differential diagnosis of the anemias.

One graph; 4 tables.

A Quantitative Method for Measuring the Gastrointestinal Absorption of Iron. John D. Bonnet, Albert B. Hagedorn, and Charles A. Owen, Jr. Blood **15:** 36–44, January 1960. (Mayo Clinic, Rochester, Minn.)

A simple test is proposed for evaluating the gastrointestinal absorption of iron. It begins with an oral dose of 50 μg. of stable iron labeled with 1 μc of Fe^{59}, to which about 300 mg. of ascorbic acid are added. Feces are assayed for Fe^{59} until any single stool contains less than 1 per cent of the dose. Absorption is determined on the assumption that all unrecovered Fe^{59} has been absorbed. The test was designed to minimize handling of stools by assaying whole specimens, and this process has the added virtue of increasing statistical accuracy of the measurement of radioactivity.

The main advantage of the procedure using a 50 μg. dose is that one thus obtains a normal value of absorption, which is about one-half of the dose. This permits measurement of either increased or decreased iron absorption.

With the standard test method, 19 normal women absorbed an average of 62 per cent of the dose and 22 normal men absorbed 40 per cent. In addition to this sex difference, not explained by the difference in the blood hemoglobin levels, there seemed to be a tendency toward reduced absorption with greater age.

Increased absorption of iron followed the administration of ascorbic acid whether the iron was in the ferric or the ferrous form. The concept that ferrous iron is better absorbed by man requires re-evaluation.

Two graphs; 3 tables. W. H. CARROLL, M.D.
Shreveport, La.

The Effect of Radioactive Strontium on Escherichia coli OB-26. Henrik Weisglass, Pavao Frank, and Andjela Miškulin. Radiol. clin. **29:** 10–16, January 1960. (In German) (H. W., Bakteriologische Abteilung des Zentralen Hygienischen Institutes, Zagreb, Yugoslavia)

Colonies of *E. coli* were exposed for twenty seconds to 20 mc of Sr^{90}. Changes in biochemical and serologic reactions indicated the production of mutations.

One figure; 2 tables.

CHARLES M. NICE, JR., M.D., Ph.D.
Tulane University

Determination of Cr^{51}-Tagged Erythrocyte Survival in Hemolytic Anemia During Therapy. W. Scheitlin and P. Frick. Schweiz. med. Wchnschr. **89:** 1328–1331, Dec. 19, 1959. (In German) (Medizinische Universitätsklinik, Zurich, Switzerland)

The survival rate of Cr^{51}-tagged erythrocytes was determined before, during, and after treatment in 2 patients with congenital spherocytosis, in 3 with acquired idiopathic hemolytic anemia, in 1 with folic-acid deficiency anemia, and in 1 with hemolytic anemia secondary to uremia. The radiochromium method is considered the most precise index for the assessment of therapeutic results in hemolytic anemias of various origin.

Nine graphs.

RADIATION EFFECTS—PROTECTION

Osteonecrosis of the Mandible Following Roentgen Therapy of Oral Neoplasia. E. Gandolfo and F. Mairo. Ann. radiol. diag. **32:** 169–189, 1959. (In Italian) (Università di Genova, Italy)

Mandibular necrosis in a patient who has received roentgen therapy for cancer of the oral cavity may be due (1) to the radiation, (2) to osteomyelitis related to radiation, or (3) to neoplastic extension. The differential diagnosis between these forms is of obvious importance for the correct management of the case.

(1) *Osteoradionecrosis* (Régaud) is relatively rare, but its existence has been proved. It represents essentially an aseptic necrosis, believed to be the result of radiation because it occurs within irradiated territory. The mucosa over the affected bone is ulcerated and necrotic; the teeth exhibit pyorrhea and are tender on percussion.

(2) *Radionecrotic osteomyelitis* (Vallebona) is an infectious process occurring in irradiated bone. The causal relationships between irradiation and infection in such cases are still obscure. Most authors believe that the first stage is alteration of the mucosa, with consequent stripping of the bone; denuded bone in a septic cavity such as the mouth is bound to become infected. Other authors regard the irradiation as a "preparatory" factor, while slight, otherwise innocuous trauma serves

a "determining" cause, by opening channels of infection.

(3) *Neoplastic osteomyelitis* (Vallebona) is in reality infiltration of bone by the neoplastic process, epithelial growths being more prone to this complication. Secondary infection may supervene, with the confusing presence of suppuration.

The differentiation between these three processes is seldom possible on the basis of a single test, even biopsy. Indeed, close co-operation between dental surgeon and roentgenologist is necessary for both proper diagnosis and management. Strict oral cleanliness and adequate dental care must be rigidly enforced both before and after roentgen therapy. Implantation of radium needles in the vicinity of bone should be avoided. Periodic roentgenograms of the mandible should be obtained and, at the first sign of radiolucent changes, the situation should be evaluated by correlation of all factors, from biopsy to bacteriologic study.

Six roentgenograms. E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Sterility After Radioiodine Therapy for Metastatic Thyroid Carcinoma. Huldrick Kammer and Morton J. Goodman. J.A.M.A. **171:** 1963–1965, Dec. 5, 1959. (2311 N. W. Northrup St., Portland 10, Ore.)

A 24-year-old male became sterile after receiving 563 mc of I^{131} for pulmonary metastases from thyroid carcinoma. Testicular biopsy and hormone assays suggested that radiation injury to the testes was responsible. The cancer appeared arrested, and probably cured, six years after treatment.

One roentgenogram; 2 photomicrographs.
WILLIAM MARTEL, M.D.
University Hospital, Ann Arbor, Mich.

Preliminary Assessment of the Gonad Dose Received by Patients Undergoing Radiographic Examination. C. Biagini, M. Barillà, and A. Montanara. Radiol. med., Milan **45:** 51–56, January 1959. (In Italian) Abridged translation, Panminerva med. **1:** 341–343, December 1959. (In English) (Università di Roma, Italy)

An attempt was made to assess the dose received by the gonads of patients during roentgen diagnostic examinations. Measurements were made with ionization chambers of varying types and sizes, with end-scale values ranging from 30 mr to 25 r. In every case, from 1 to 10 exposures were taken in order to obtain values detectable by the chambers used. The examinations considered were those in which the abdomen was exposed to the direct beam of radiation, *i.e.*, studies of the lumbar vertebrae and pelvis, urography, cystography, cholecystography, stratigraphy of the bladder and of the lumbar column, and examinations of the digestive tract. A certain number of tests were performed directly on patients undergoing the examinations and other observations were made on phantoms.

The results are tabulated. Generally speaking, the values obtained tally with those reported by others.

Seven tables in the original; 3 in the translation.

Maximum Permissible Doses from the Point of View of Radiation Genetics. H. Marquardt. Atompraxis **6:** 20–25, January 1960. (In German) (Forstbotanisches Institut der Universität Freiburg i. Br., Germany)

A brief survey is given of the problems of spontaneous and induced mutation in so far as they are important for an evaluation of maximum permissible doses and concentrations. The maximum permissible concentration for radioactive isotopes, the relative genetic effectiveness of various types of radiation, and the effect of slight doses of radiation have not been sufficiently verified from the experimental genetic point of view. The induced total mutation stress in a population includes chemically induced and radiation-induced mutations; at present, the approximate extent of the chemically induced mutation rate cannot even be estimated. Owing to recent findings in mouse genetics, the concept of the doubling dose has become problematical. Thus the genetic data necessary for dealing with special questions of borderline-dose determination are not available in sufficient quantity; therefore the geneticist cannot recommend any dose exceeding basic radiation below which a genetic risk can be excluded with certainty. Rather, each single factor should be kept as low as possible. In regard to the fate of future generations there is an urgent need of genetic research comparable with that in technology and atomic physics.

Four figures; 2 tables. AUTHOR'S SUMMARY

Reduced Gonadal Irradiation in Prenatal Chest Roentgenographic Examinations. Lewis E. Etter, Charles N. Chasler, and Lawrence C. Cross. Am. J. Roentgenol. **83:** 357–362, February 1960. (University of Pittsburgh, Pittsburgh, Penna.)

Prenatal roentgenographic examinations conducted by competent radiologists yield valuable information which far outweighs the theoretic genetic damage to the mother and fetus. Nevertheless, it is desirable to reduce radiation doses to the lowest possible values.

The use of the usual technics and 14 × 17-inch film for prenatal chest examination exposes more of the abdomen and fundus of the uterus than is necessary. In about 80 per cent of women, the supradiaphragmatic portions of the thorax can be demonstrated on a 14 × 11-inch roentgenogram. This represents a saving of 24 cents per film and a 36 per cent reduction of the area of exposure when the beam is properly collimated. Use of a rectangular or square collimator rather than a round cone, along with added filtration of aluminum and copper, reduces greatly the irradiated area and a much smaller dose is delivered to the patient and fetus. Since the gonads will usually be in the field of irradiation in cephalic presentations, the reduction of dose and pinpoint accuracy in positioning is important in prenatal roentgenography.

A somewhat greater dose of radiation to the patient and fetus is given in photoroentgen chest examinations than in the usual 6-foot roentgenography. If a rectangular 11 × 14-inch area is collimated for the photoroentgen examination and there is added aluminum and copper filtration, the dose to the fetal gonads can be reduced up to 92 per cent. For reduction of gonadal irradiation in prenatal chest roentgenography, the following recommendations are made:

1. That standard large chest roentgenograms be made on 14 × 14-inch film.
2. That 4 × 4-inch photoroentgen film be substituted for the 4 × 5-inch film.
3. That all roentgen beams be collimated in squares or rectangles to the exact area of interest.
4. That more filtration with aluminum and copper be used.

Fifteen roentgenograms; 3 diagrams; 2 graphs.
JOHN P. FOTOPOULOS, M.D.
Northwestern University Medical School

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